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Magazine of Flight Operations · MARCH 1955

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The Installation Barrier

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Aircraft Spacing Under IFR Conditions

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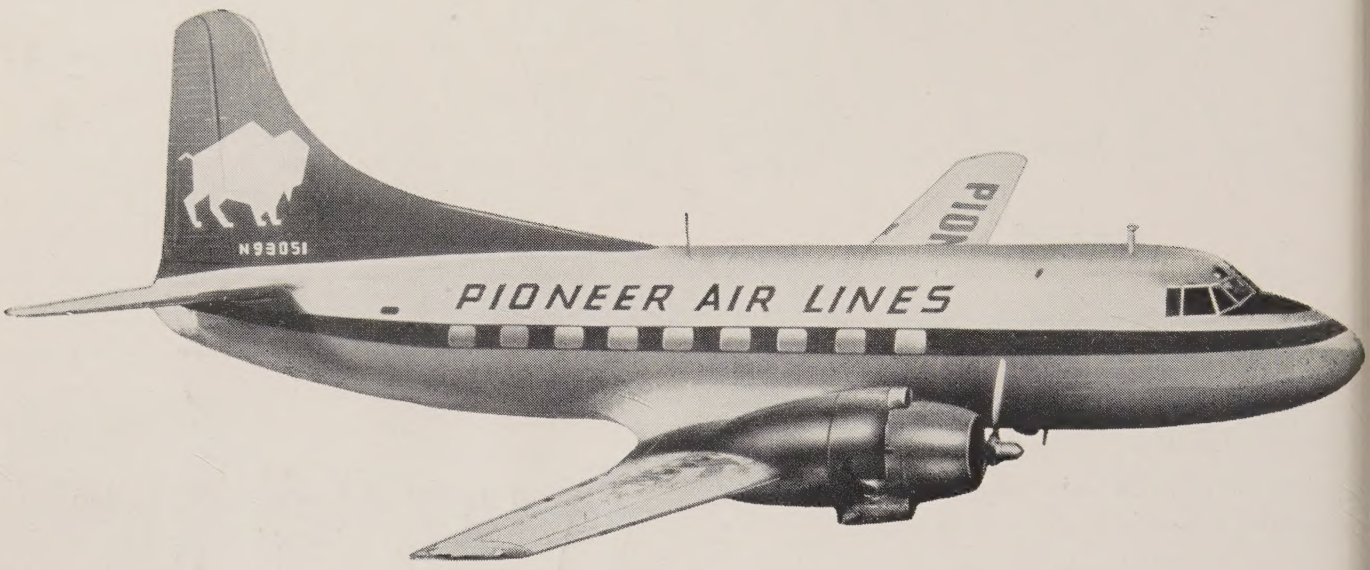
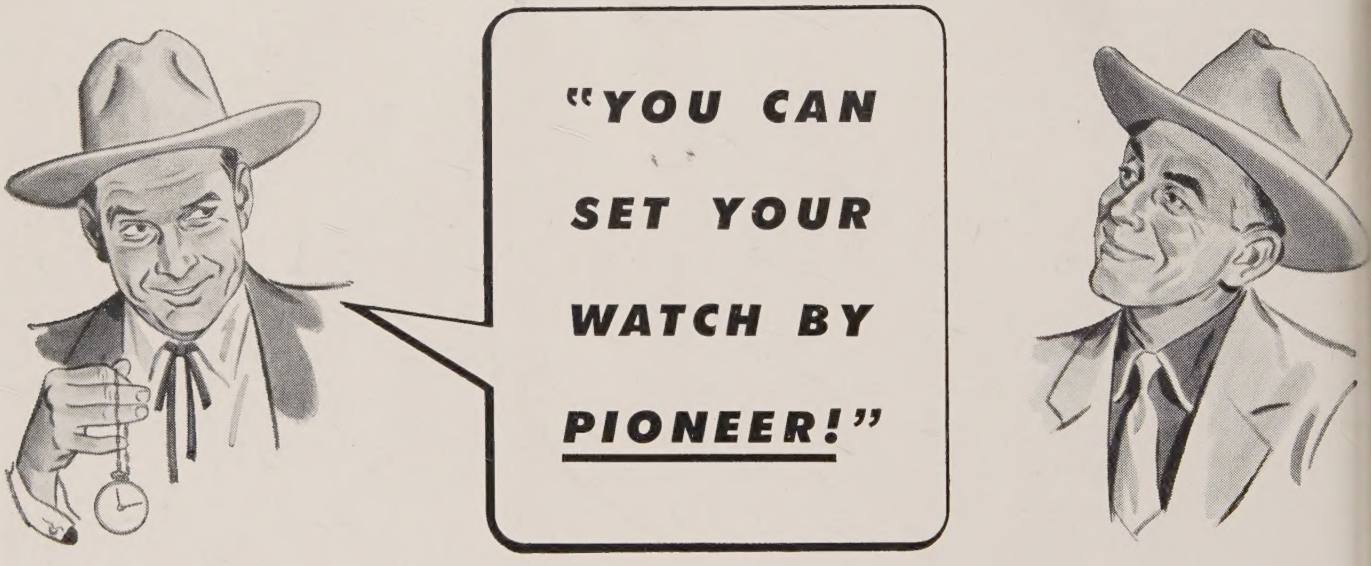
Flight Operations Round Table:
Problems in Approach Lighting



Said The Man From Albuquerque To The Man From Abilene:



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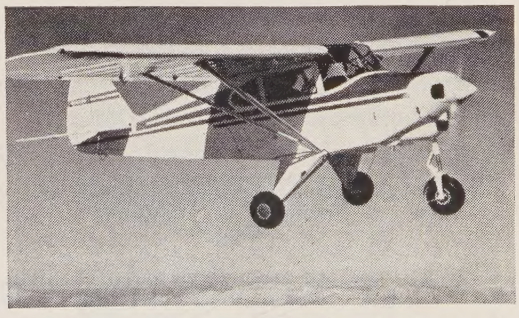

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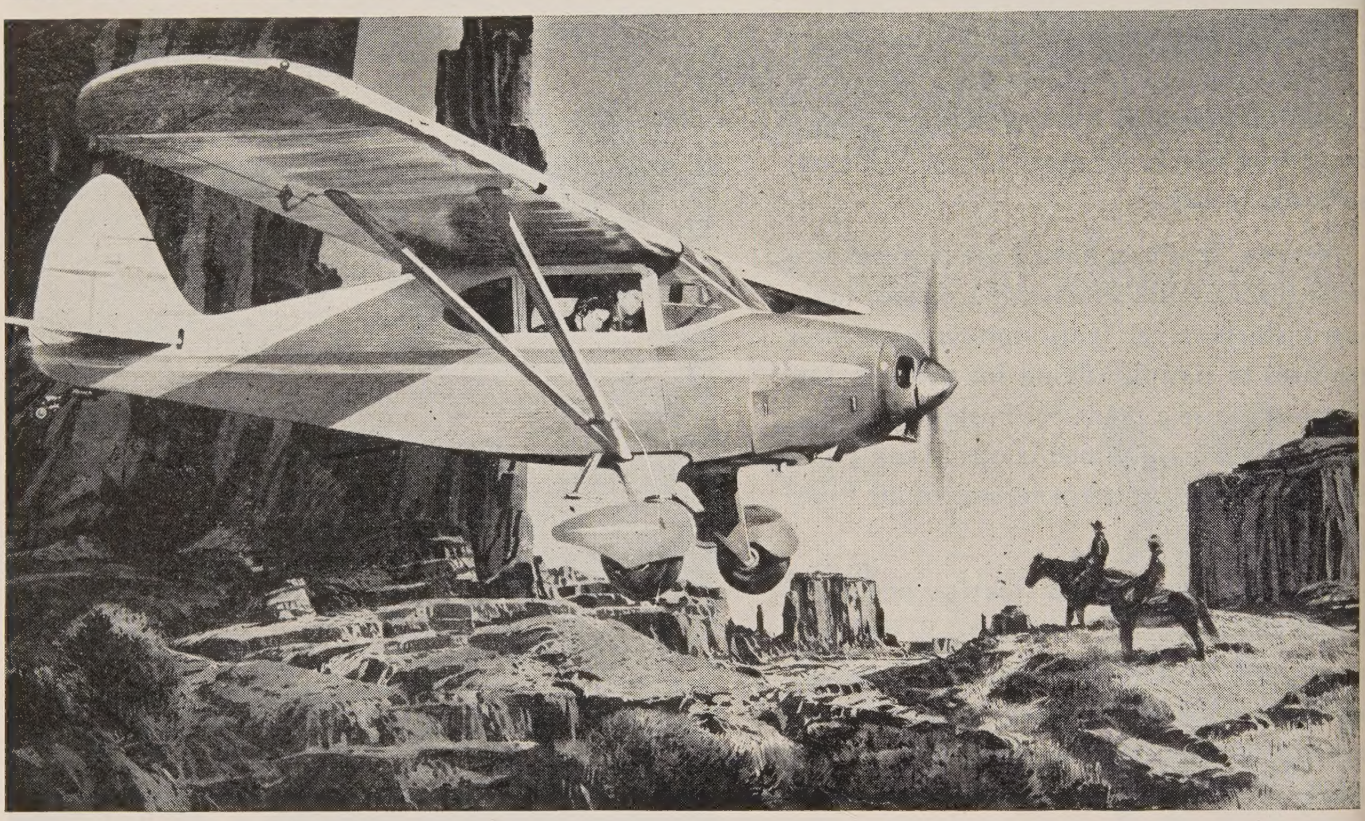
PLANE FAX

Your Best Week-end Flight Plan for March

Plan to visit Nevada's Valley of Fire any week-end this month, while the desert flowers are in bloom. Land at nearby Boulder City Airport for boat and motor transportation and for quality Standard Aviation products.



Listening for uranium in Monument Valley

Prospecting from the air! Skirting cliffs, hopping over boulders, and dodging pillars of rock, "Ace" Hibbard spent days flying through Utah's weird, desolate Monument Valley carrying a modern prospector and his radiation counter. Whenever they heard the hum that indicated uranium, his job was to drop closer to the desert floor and fly tight circles until the hot spot was noted on their maps.

A pilot who is also a certified A & E, Mr. Hibbard says, "Low flying over the desert calls for plenty of available extra power, and I make sure of it with Chevron Aviation Gasoline 80/87. I do a lot of mountain flying near my home port at Auburn, California, and Chevron 80/87 always gives me the extra power I need.

"I keep all my engines running clean and free, too, with RPM Aviation Oil. I've never seen another oil clean out sludge so well, and hold down head deposits at the same time. I made a top overhaul at 700 hours, and the pistons were so clean I could still read the stamped letters on their tops."

TIP OF THE MONTH

It's a good idea to keep your windshield spotless and unscratched. This can be a big help in giving you better vision on night flights.

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MARCH, 1955

Skyways

Flight Operations • Engineering • Management

COVER: Bell VTOL

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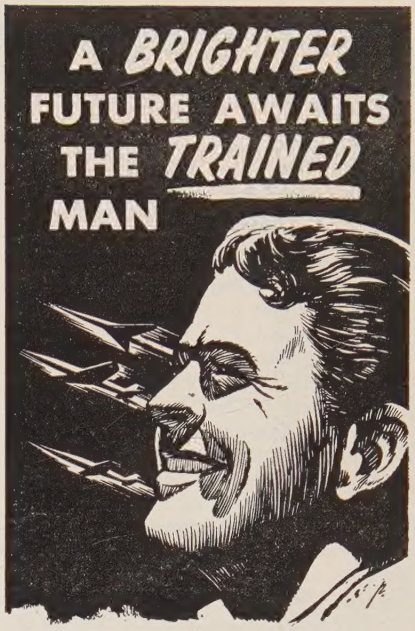

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PERSONNEL

Earl D. Johnson, former undersecretary of the Army, has been named senior vice president-development and operations of General Dynamics Corp.

Lawrence W. Farrell recently was appointed Assistant to the Vice President of Ford Instrument Co., a division of The Sperry Corporation.

B. Allison Gillies, West Coast associate of Jones and Gillies, Inc., Aviation and Management Consultants, Washington, D.C., was elected a member of the Board of Directors of Pacific Airmotive Corporation.

John K. Northrop, founder and former president of Northrop Aircraft, has been elected a member of the Board of Directors of The Garrett Corporation.

Paul A. Pitt was named chief engineer of Solar Aircraft Company and **William C. Heath** was named executive engineer-marketing. **Philip M. Klauber** has been named chief administrative engineer.

William E. Nickey has joined Piasecki Helicopter Corporation as assistant to the President. **Horace G. Prall** joined Piasecki as chief inspector.

Nelson H. Mageoch has been appointed Vice President-Operations, and **John C. Merman,** Vice President-Manufacturing of Daystrom Electric Corporation.

Edgar F. Nason, who resigned from Elastic Stopnut Corp., has joined the Kaynar Company, Los Angeles, as General Sales Manager.

Dr. Joseph Silverman has been promoted to head of Research Department, Laboratory Division for Walter Kidde Nuclear Laboratories, Inc.

John A. Lawrence recently was appointed Manager-Sales for General Electric Company's Schenectady Aeronautic and Ordnance operation.

Dr. David B. Langmuir has been named to the staff of The Ramo-Wooldridge Corporation's Guided Missile Research Division. **Dr. Melville C. Branch, Jr.,** and **Charles A. Moreno** also have joined The Ramo-Wooldridge Corp.

Edwin B. Stickle and **John Sloan** have been appointed Military Sales Representatives for Pastushin Aviation Corp. **Sam T. Wolf** was named Administrative Engineer, and **Larry Kooi,** Manager of Material Control.

Robert A. Anderson was named General Sales Manager of Resort Airlines, Inc.

W. B. Agler was appointed general manager of Aircraft Products Division of the Kawneer Company.

J. Woodrow Thomas, Director of State Affairs for Trans World Airlines, has been transferred from Kansas City to Washington, D.C., and is now Director of Civic Affairs, TWA. **W. T. Huff** has been named Assistant Director of Civic Affairs.

E. W. Winegard was appointed a sales engineer for the Bowers Battery & Spark Plug Co., Reading, Pa.

Joseph L. Hochman was named Plant Manager of the Aircraft Products Division of Air Associates, Inc.

Arnold Challman recently was named administrative assistant to Manager T. S. Carley at Minneapolis-Honeywell Regulator Company's regional sales office in Chicago. **R. C. Ferguson** was chosen to manage M-H's Peoria branch office while **R. R. Scott** was named the new manager of the Davenport office.

George P. Braender has been named U. S. sales manager for VARIG Airlines of Brazil. His office will be in New York.

William P. Brotherton has been promoted to public relations manager of Ryan Aeronautical Co.

James W. Austin, vice president of traffic and sales for Capital Airlines, has been elected a member of Capital's Board of Directors.

Aksel Nielsen, president of the Mortgage Investment Company and Title Guaranty Company of Denver, was elected to the Board of Directors of United Air Lines.

Walter P. Plett, former Regional CAA Administrator at Anchorage, Alaska, has been transferred to CAA Region 4 as Deputy Regional Administrator. His headquarters will be in Los Angeles. **Allen D. Hulen** replaces Mr. Plett as Regional Administrator in Anchorage, while **Henry L. Newman** becomes Deputy Regional Administrator.

John F. Davidson has been appointed assistant to the president and board chairman of Pacific Airmotive Corporation. **L. B. Littrell,** former manager of PAC's Burbank Division, has been upped to vice president of aircraft service. **William Maxfield** has been appointed manager.

Robert H. "Bob" Wood has joined McDonnell Aircraft Corporation as assistant to the president for public relations.

E. Thomas Burnard recently was named Executive Secretary of the Airport Operators Council. Mr. Burnard formerly was associated with the Air Transport Association.

Jack W. Hale has been appointed vice president and general manager of Chamberlain Engineering Corporation and Chamberlain Aviation. **W. B. Carrell** has been named executive vice president of Chamberlain Aviation.

James M. Glod was appointed director-cargo services for American Airlines.

W. J. Connell recently was named superintendent of the aircraft overhaul division of Southwest Airmotive Company. He replaces **George H. Kelley** who has been appointed Southwest's facilities engineer.

Rod Strouse has been named assistant sales manager of E. B. Wiggins Oil Tool Company, Los Angeles.

HONORS

Ernest G. Stout, staff engineer for Convair-San Diego, was honored recently at the centennial celebration of New York University's College of Engineering. Mr. Stout was selected by the Centennial Committee as one of the 100 alumni "representing those whose significant achievements have

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brought distinction to themselves and their alma mater." Mr. Stout received an inscribed honor scroll.

Earl C. L. Clevell was presented the Air Force Exceptional Service Award in recognition of his provisioning activities for the Air Force.

Earl D. Johnson, president of ATA, was named to receive the University of Denver School of Aeronautics' annual Achievement Award.

COMPANIES

George D. Auchter Co., of Jacksonville, Florida, has been awarded a contract by Fairchild Aircraft for the construction of an aircraft repair and modification base adjacent to the St. Augustine Municipal Airport.

Koehler Aircraft Products Co. has been sold to the New Britain Machine Co. **Robert T. Frisbie** has been named president of the new Dayton, Ohio subsidiary of the New Britain (Conn) Machine Co.

The Garrett Corporation has announced the establishment of a new Military Relations Dept. **W. J. Pattison** heads up the new activity.

Aircraft Radio Corp., Boonton, N.J., has acquired Orion Industries, Inc., of Richmond, Va. Present plans call for continuation of activities at the Orion plant.

Ketay Instrument Corp. has merged with The Norden Laboratories Corp., and **M. F. Letay** has been named president of the combined companies.

AERO CALENDAR

Mar. 11—IAS Nat'l Flight Propulsion Meeting (restricted), Hotel Carter, Cleveland.
Mar. 12-17—Florida Aero Club's Miami-Cuba spring Air Cruise.
Mar. 20-23—Aero Medical Association Annual Meeting, Hotel Statler, Washington.
Mar. 28-Apr. 1—American Society for Metals exposition and congress (incl. aircraft and rocketry), Pan Pacific Auditorium, Ambassador Hotel, Los Angeles.
Apr. 5-7—RTCA spring assembly meeting (with Institute of Radio Engineers), Los Angeles.
Apr. 16-20—American Association of Airport Executives annual meeting, El Conquistador Hotel, Tucson, Arizona.
Apr. 18-21—SAE Golden Anniversary meeting (aeronautics), product forum and engineering display, Hotels Statler and McAlpin, New York.
Apr. 20-22—American Rocket Society spring meeting, Baltimore.
Apr. 24-28—Airport Operators Council annual meeting, Hotel Olympic, Seattle.
Apr. 28-30—American Helicopter Society annual forum, Mayflower Hotel, Washington, D.C.
May 4-6—Fourth Annual International Aviation Trade Show, 69th Regiment Armory, New York City.
June 6-10—Human Engineering Institute, Dunlap and Associates, Stamford, Conn.
June 12-17—SAE summer meeting, Atlantic City, N.J.
June 21-24—Joint meeting IAS and RAS (Great Britain), IAS Bldg., Los Angeles.
June 21-24—Aviation Distributors and Manufacturers Association mid-year meeting, Breezy Point Lodge, Brainerd, Minn.

CONTINENTAL...

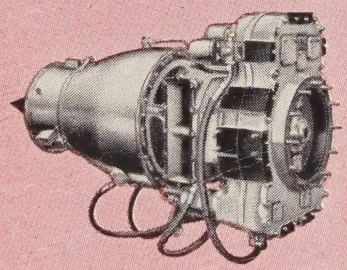
Out in Front in Helicopter Power

New, modern helicopters are finding it increasingly beneficial to make use of the latest Continental developments for power production. Two examples of recently tested engines built around Continental power plants are shown. One—the Sikorsky XH-39 at left, above—employs the CAE Model 220 shaft turbine; the other—Cessna's CH-1 at right—uses CMC Model FS0470 piston engine. Both are unique.

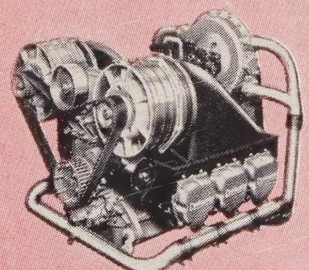
The XH-39—first helicopter with completely retractable landing gear—holds the world's record for helicopter altitude (24,500 ft.) and in addition, the world's record for helicopter speed (156.005 m.p.h.). The CH-1 features simplified design, using one-third fewer gears. Location of engine in the nose makes for ease of access, promotes efficient cooling, and frees the center of gravity behind the cockpit for use in disposable load.

Thus Continental supplies each type of power plant to suit the peculiar requirements of two widely different modern helicopter design concepts. Additional power plants engineered for their suitability for helicopters will be forthcoming from the Continental organization within the near future, and great things can be expected.

Outstanding Engines of Both Types... Piston and Turbine... Embody Results of Experience Dating from 1902



CAE MODEL 220 SHAFT TURBINE—425 H.P., 290 LBS.



CMC MODEL FS0470 SUPERCHARGED AND FAN-COOLED HELICOPTER ENGINE—260 H.P.

MEN WHO LOOK TO THE FUTURE LOOK TO THE AIR FORCE RESERVE

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industry notes . . .

■ Panagra has received three of the first X-band RDR-1 radar sets (Bendix) for installation in its DC-7B's which will go into service between the U.S. and South America. Meanwhile radar also is being installed in Panagra's DC-6B and will be flown on its regular schedules to familiarize flight crews with the radar's operation.

■ Convair Division of General Dynamics Corporation has submitted its entry in the American Airlines short/medium-range turboprop airplane competition. Convair's entry is basically a four-engine, 60-passenger elongated version of the Convair-Liner. It was offered with several different powerplant combinations: the Rolls Royce *Dart*, the Allison T-56 and the Napier *Eland*.

■ Fairchild Engine & Airplane Corporation has sent two engineers to Amsterdam to check progress on the Fokker F. 27 *Dart* -powered turboprop transport. Fairchild is the American licensee for production and sale of the 33,000-lb, 42-passenger aircraft which has been designated "the modern successor" to the DC-3 and other later twin-engine (piston) designs. The prototype of the $400,000 pressurized F. 27 is scheduled to go into flight test early this summer.

■ Link Aviation, Inc., has delivered its 500th C-11 jet ground trainer to the Air Force. The C-11 is being used in military flight training programs as a transition-type instrument trainer. To date, Link C-11's are being used at more than 100 air bases throughout the U.S. and free world.

■ United Air Lines has placed an order with Collins Radio Company for $1,000,000 of airborne radio equipment. The order calls for 224 VHF receivers and 224 VHF transmitters (360 channels) to replace United's currently used 50-channel VHF equipment. Installation on UAL's fleet is expected to begin within the next few months.

■ A North American FJ-3 *Fury* has established what is believed to be a new altitude climb record. Piloted by Lt. Cmdr. Salty Moore, the jet *Fury* reached an altitude of 10,000 ft in 83 seconds (from release of brakes). This record cuts 17 seconds from the best previous attempt by a Grumman F8F.

■ Sabena Belgian World Airlines has purchased two more Sikorsky S-55 helicopters for operation on routes to eight cities on the European continent. Since Sabena began using copters in 1950, it has piled up more than 12,000 hours of copter flying.

■ A project team has been assigned to handle design and development of a small jet engine for the Air Force, at General Electric's Small Aircraft Engine Dept. Officially designated the MX2273, the engine is being designed to power drones and pilotless aircraft.

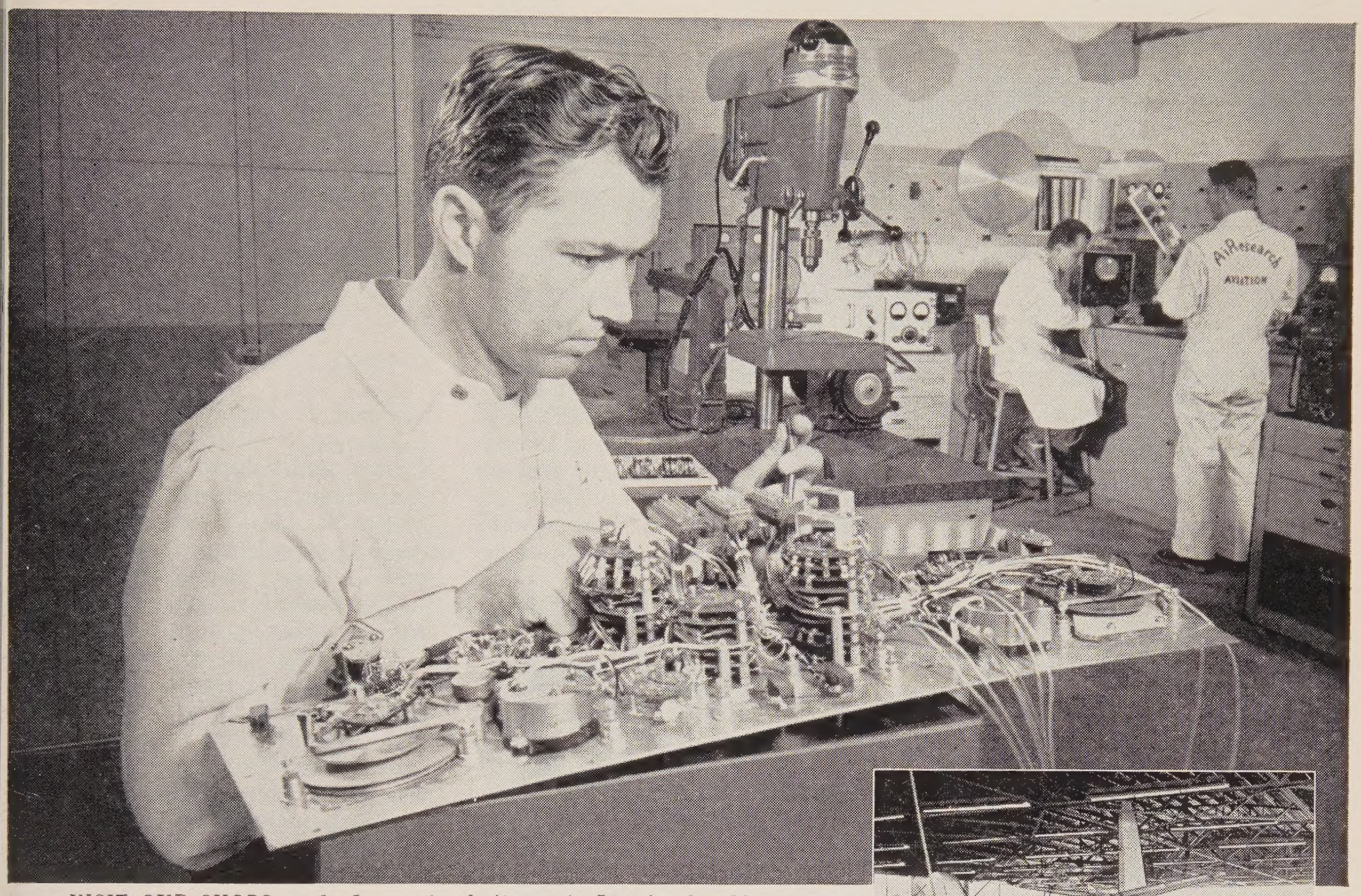
■ A recent report indicates that for the year 1954 Beechcraft commercial plane sales totaled more than $20 million, and Beech commercial sales for 1955 are expected to show an increase of 25% over those of '54.

■ Braniff International Airways is running tests on a Du Mont airborne radar set (Type APS-42B) which can receive information from distances up to 200 miles. The equipment was designed specifically to warn pilots of dangerous terrain, hazardous weather and as a navigation aid. Braniff has installed its test unit aboard one of its DC-6's.

■ Ryan Aeronautical recently was awarded a multi-million dollar contract to build aft fuselage sections of the North American F-86. This contract is in addition to the subcontract Ryan was awarded for fuselage sections for the Boeing KC-135 jet tanker-transport.

■ The Air Research and Development Command has announced the first flight of its experimental all-magnesium airplane (F-80C) at Mitchell AFB, N.Y. The almost 100% magnesium airframe was built by East Coast Aeronautics, Inc., under contract to ARDC.

Now! Finest radio and electronics service center for business aircraft!



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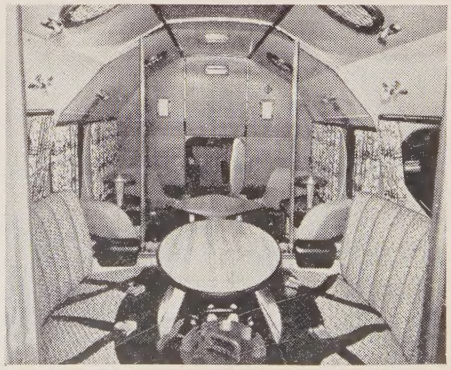

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ELFAKA Flush-Type Lighting

Approach lights scheduled for test at Knoxville; air-carrier pilots hope to prove to military there is no need for side lighting with centerline

by Franklin D. Walker

A Dutch-designed flush-type fixture, adapted successfully at several European airfields and scheduled to be tested at Knoxville this year, may solve the controversy between the Air Force and the airlines over unlighted overrun areas in centerline approach light systems at civil-military airports in the United States.

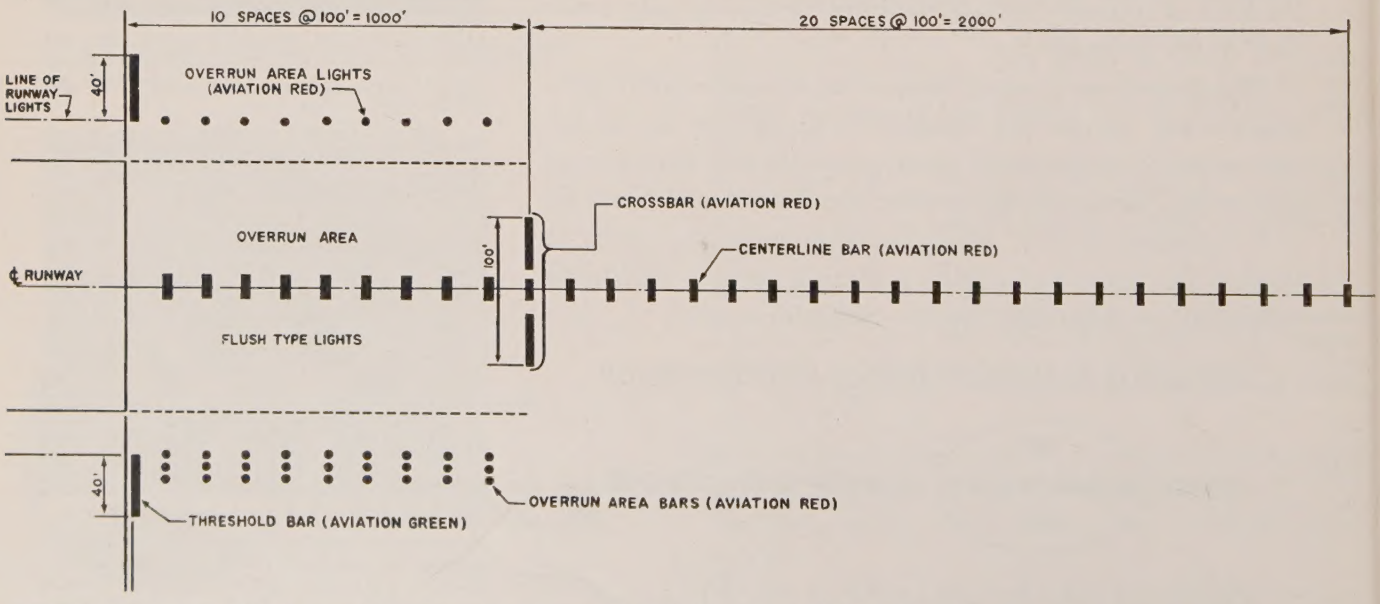
It is the Elfaka flush light developed by the Netherlands firm of N. V. Ima in cooperation with the Dutch government. The American agent and licensee is the Lighting Division of Structural Concrete Products Corporation of New York.

The Elfaka light comprises a rectangular steel grid, designed to withstand the direct landing impact of the largest commercial and military aircraft, and a battery of high-intensity lights. The grid is imbedded flush with the surface of the ground in the approach area so that its longitudinal direction conforms to the direction of the runway and to the axis of the aircraft's approach. Beneath the grid are batteries of high-intensity lights installed at an angle to shine upward through the grid into the path of the approaching airplane.

The lights can be operated from the control tower and can be dimmed or brightened as conditions warrant. A combination can be used to give almost any desired result. For example, when placed in longitudinal series, the lights are adaptable to centerline approach and centerline landing. When placed abreast at right angles to the centerline but still parallel, they outline the touchdown line. If further differentiation between approach and landing areas is desired, it can be achieved through the use of steady or flashing signals or a variance in spacing.

Elfaka approach lights have been installed for some time at Volkel, Eindhoven, Soesterberg, Leeuwarden, Deelen, and Schipol Airports in the Netherlands. More recently, the same system has been installed at Vandel, Aalborg, Skrydstrup, Tirstrup, Karup and Vaerloese, new military airports in Denmark, for flush threshold and runway light requirements.

Operational use of the Elfaka approach lights in Europe, particularly at airports used by NATO jet fighters and piston-engine transports, has proved their effectiveness in the 1,000-ft overrun area during low-weather approaches. Damage from impact and jet exhaust heat is negligible and the radiant heat of the lamps is sufficient to melt moderate snow and ice. Heating elements may be installed where heavy snow and ice occur. Water drops down through the Elfaka grid into a dry well or into an airport drainage system.



CONFIGURATION B *which is reportedly planned for Logan Airport, Boston, and for the test installation at Knoxville Airport (Tenn.) features flush centerline lighting in the overrun area as well as the Air Force-required side lighting. Note combination in overrun area*

The Elfaka light can be modified to meet whatever specifications are required.

The decision to test the Elfaka approach lights in the United States stemmed in part from results of their use in Europe, but largely from dissatisfaction with the U.S. national standard for approach lighting as established by the CAA on recommendation of the Air Coordinating Committee last year.

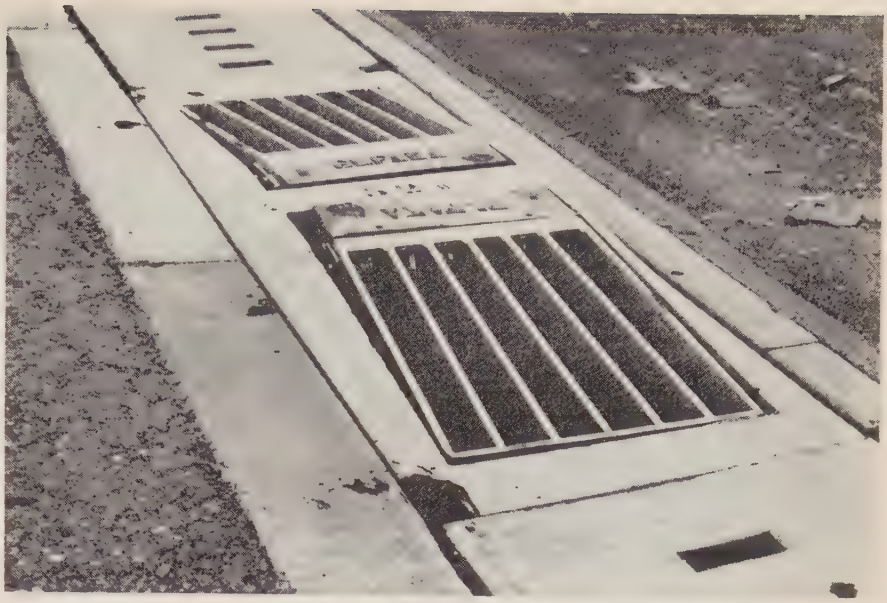
Pilots contend that the national standard is, in practical application, a dual approach lighting standard as far as joint-use airports are concerned. It establishes Configuration "A," a 3,000-ft centerline with 1,000-ft crossbar, as the standard, except where military operations require an overrun area. In such cases, Configuration "B," a 2.000-ft centerline up to the 1,000-ft crossbar and two side rows of overrun lights in the overrun area, becomes the standard. According to pilots, the absence of lights in the center between the runway threshold and the 1,000-ft crossbar creates a hazardous condition for transport passenger operations in that it does not give the pilot proper guidance. For safe schedules in low-weather approaches, centerline lights must extend down to the runway threshold, they are convinced.

The inadequacies of the present dual standard in meeting operational requirements of commercial and military aircraft at joint-use airports, plus the jumble of lighting systems in use across the country, led to the demand for a single standard which would serve both users without major modification.

The Air Force, the Civil Aeronautics Administration, the Air Transport Association and the Air Line Pilots Association have agreed that a flush-type fixture appears to hold the answer to the problem of overrun areas. Knoxville was selected for evaluation of the Elfaka system, because it utilizes a Configuration "B" overrun approach light system. The installation will include 18 Elfaka units at the threshold, 11 at the start of the overrun area, and 7 sixteen-foot bars installed in tandem.

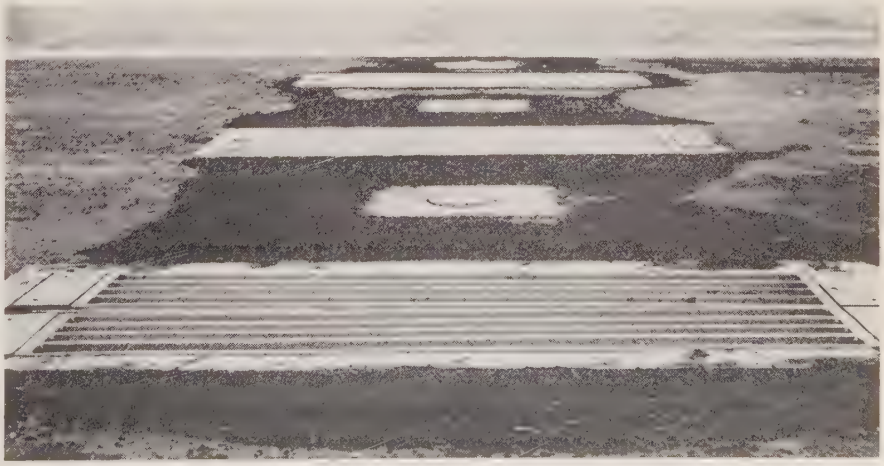
It has been agreed that the Air Force and CAA will also retain the side lights in the overrun area. However, most of the air-carrier pilots contend that, despite the claim among high-echelon Air Force people that side lights are necessary, AF pilots themselves say they are not needed where flush lights are installed. They point to Schipol, Soesterberg and other European fields where NATO F-84 jets are operating every day with

(*Continued on page* 42)

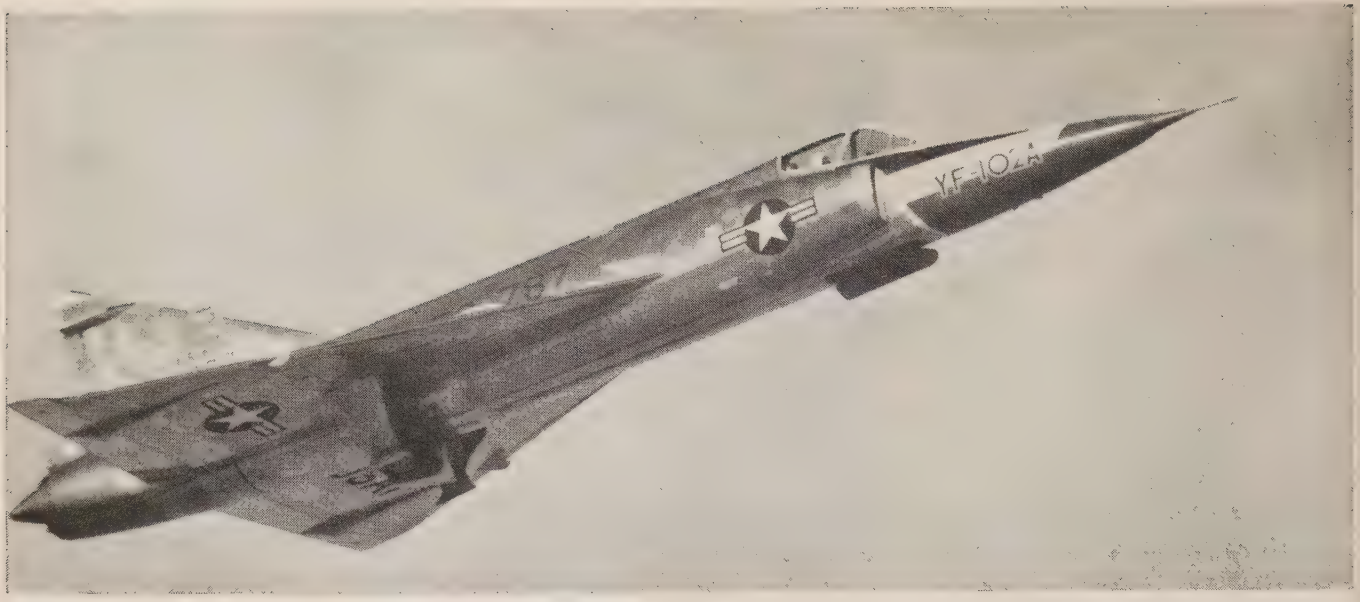


ELFAKA UNITS *mounted back-to-back provide lighting in two directions. Light is in watertight box, placed against an iron grid and whole units installed in concrete block*

THRESHOLD *light is Elfaka Type 3130 E. Eighteen of these units are scheduled to be installed at Knoxville for evaluation. This installation (above) is at Deelen, Holland*



TOUCHDOWN *point light is Type 0200 D high intensity light; Type "Toplight" is low intensity, Danish Air Force chose Elfaka system for new military airport lighting in Denmark*



SUPERSONIC *fighter aircraft at Mach 3 develops heat at a rate which would melt a ton of ice per minute. At Mach 4 sustained flight would raise the aircraft temperature to 1,000°F without refrigeration. This heat load is one of problems facing designers*

The Installation Barrier

by Robert L. Nordli

Asst. Chief, Engine Installation Section
Wright Air Development Center

Man is forever encountering obstacles as he advances in all fields of endeavor. Within the aircraft industry, many of these so-called obstacles have arisen only to be conquered by the persevering men of science. The most recent barrier which was overcome was the sonic barrier. Today, it is far behind us. Now the aerodynamicists are crying about the thermal barrier.

For many thousands of years man has observed large fiery-red objects approach from outer space and enter the earth's atmosphere. As they sped toward the earth, they would glow brighter and brighter. Soon, a long red tail seemed to fix itself to the object and almost as soon as it appeared, it disappeared. At one time man thought it was the working of the gods. Now we know better. It was merely a meteorite; a physical substance which had escaped the gravitational control of its mother planetary system. The entry of this meteorite into the earth's atmosphere was the first witnessed display of the "thermal barrier" in action.

When the meteorite entered the earth's atmosphere, it met a resistance which tended to impede its movement. Friction, too, played a part. As the kinetic energy of the object was expended in the form of heat, the object oxidized and eroded until it was entirely consumed.

We are now faced with this identical barrier in the development of supersonic aircraft. However, it is not insurmountable, for man is daily finding answers to these problems and others associated with supersonic flight.

One of the problems which have arisen as the result of the development of high-thrust engines to attain supersonic speeds, is the installation problem of fitting and utilizing this huge prime mover within the confines of the airframe. This is the "installation barrier."

Engine Installation

An aircraft consists of the basic airframe, an engine, and a multitude of other components and systems which function together as a weapons system. The engine and airframe are seldom developed concurrently. A few engines have been developed exclusively for utilization by some specified airframe design. More commonly, however, the engine is developed independently and with potential application to numerous airframe designs. It would be advantageous for the aircraft vendor to have available at the inception of his airframe design, a finalized engine design. But all too often the engine design lags or is concurrent with the airframe design. The airframe manufacturer must then adapt his aircraft to accommodate the developed engine. The engine installation comprises that equipment necessary for the compatible marriage of these two main constituents, the engine and the airframe. A schematic sectioned engine installation is shown in *Figure 1*. The equipment necessary for joining these items includes the physical engine installation, the exhaust and induction system, all fluid lines and connections, and all the equipment necessary to obtain satisfactory control over the environment to which the engine and its components are exposed. The material contained herein is not necessarily restricted to supersonic aircraft but to those aircraft which could be categorized as high-performance.

One of the main problems associated with engine installations, particularly the gas turbine, is that of cooling the installation and the equipment contained within the engine bay. Engine installations in some planned supersonic aircraft will be subjected to astronomically high heat loads, compared to those encountered on earlier subsonic aircraft. This is composed of energy dissipated by

the engine and that generated by aerodynamic friction.

What is this aerodynamic heat load, its magnitude, and its effect on the engine installation? This temperature rise of air impinging against the aircraft during flight can be determined if it is completely stagnated and is an adiabatic process, *i.e.*, if no heat is added or taken from the air during the time that the air is accelerated to the speed of the aircraft, then the temperature of the air can be computed easily. The temperature rise of air is equal to:

$$T = 1.792\ (V/100^2,\ °F)$$

where $V = TAS$ *in mph*

The temperature of stagnated air at various Mach numbers for an ambient temperature of —67°F and 100°F is shown in *Figure 2*. From this chart it is apparent that the temperature of the air stagnated at speeds only slightly above Mach 1 on a hot summer day presents a formidable obstacle by present design standards. At sea level, ram air temperature is 200°F at Mach 1, 350°F at Mach 1.5, and it tops 450°F at Mach 2. Fortunately, in actual practice the full adiabatic temperature rise is not experienced. The mean temperature of the boundary layer is well above that of the surrounding air. Thus, an appreciable amount of heat is transferred out of the boundary layer, preventing it from ever attaining its full temperature rise. The ratio of the actual to the theoretical temperature is known as the "recovery factor." This factor is about 85% in actual practice. However, this is only part of the thermal obstacle to be overcome. The other source of heat, the engine itself, presents a major problem.

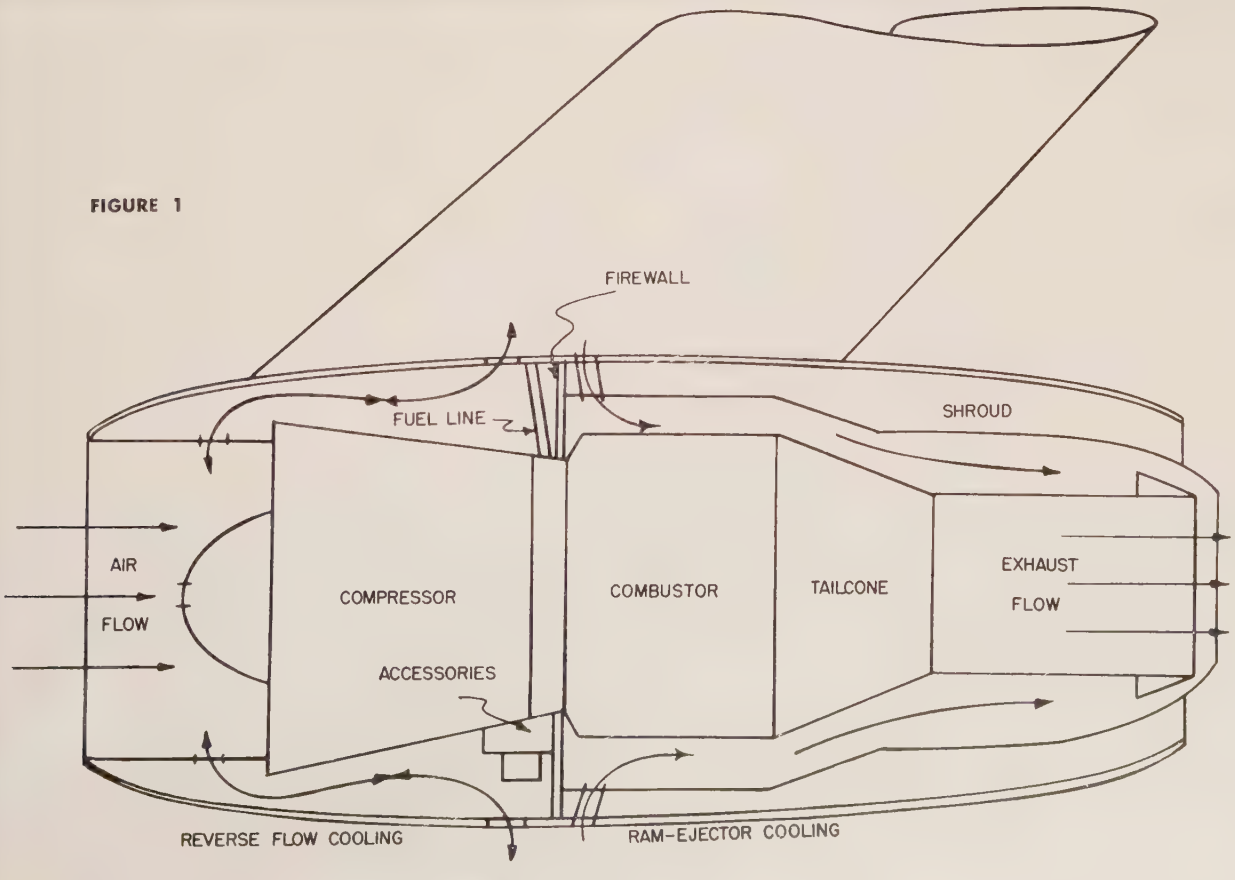
In modern aircraft, improved performance is being attained by reducing the size of the aircraft and by increasing the performance of the engine. To reduce the size of the aircraft, the tendency has been to reduce the percent allowable volume for installation of the engine. Improvement in performance of the engine has been attained by increasing the air-handling capabilities and the internal operating temperatures and pressures. Because of this, the mass flow and companionate total thrust of the engine has been rising with advances in design. At supersonic speeds the engine is gulping hot air at a tremendous rate, compressing it, making it manyfold hotter, and then burning it at the maximum temperature the materials of the engine will permit. All this has resulted in an increased heat load per unit surface area of the engine. In turn, this energy is being dissipated to a more restricted installation volume.

Engine Bay Cooling

Practically the entire aircraft and all of its equipment in some way influence the cooling problem. The tremendous amount of heat which is generated within the engine bay or transmitted to it must be dissipated. Obviously, the engine air entering from the front of the aircraft cannot carry away all of the heat, for at most supersonic speeds this air is heated to a temperature exceeding the allowable operating temperature of many of the engine components. Many designers have cast covetous eyes in the direction of the aircraft fuel which continuously is occupying a larger portion of the interior space of the aircraft. Others have recognized that some artificial means of refrigerating the sensitive components is mandatory.

Purely from a cooling standpoint, the Air Force has undertaken, by contract, to determine the heat load and the temperatures which will be encountered at supersonic speeds; to determine the best methods of locating components for obtaining optimum cooling; and to ascertain the optimum cooling methods for aircraft at various flight speeds and altitudes. New York University recently completed a study for the Air Force and prepared a report as a result of that study, titled "*A Method of Predicting Skin Compartment and Equipment Temperatures for Aircraft.*" In addition, the AF has contracted for a study of methods of locating fuel tanks to alleviate fuel heating and for

FIGURE 1



ENGINE INSTALLATION

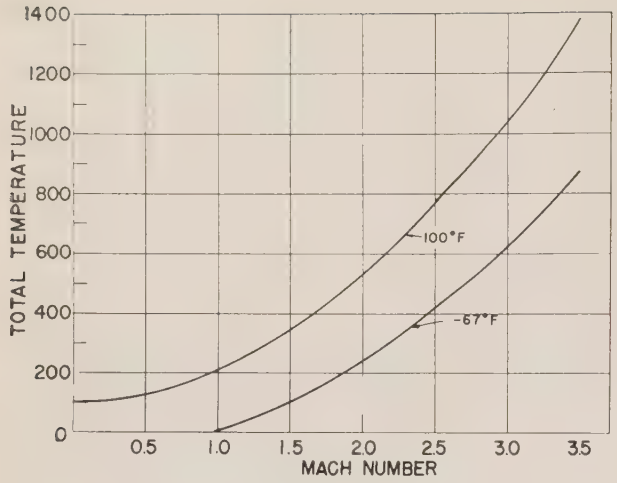


FIGURE 2

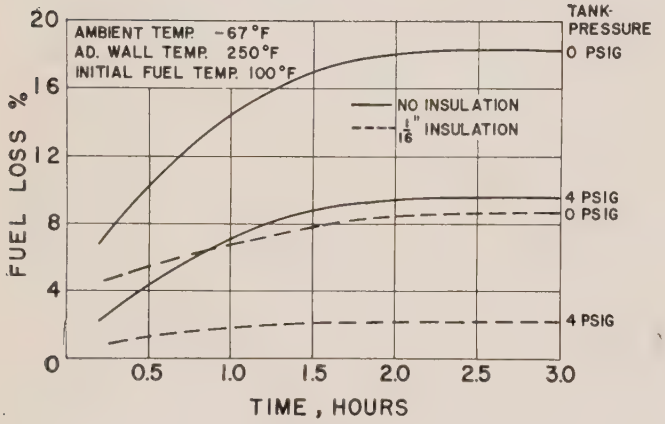


FIGURE 3

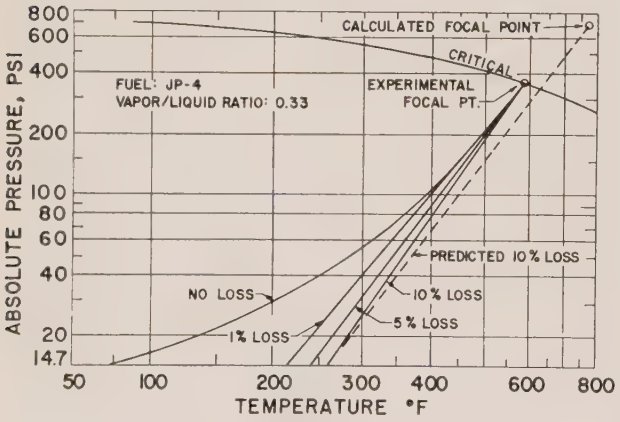


FIGURE 4

determining optimum engine-bay cooling configurations for various supersonic operating conditions. Reports on the New York University study are now available to industry and it is expected that reports on other studies will be available soon.

The need for cooling of the engine bay is apparent. Up until now, most of the components have been designed for temperatures up to about 160°F. Some of these components can be made to operate at about 250°F with slight redesign or modification, but to operate above this temperature curtails the life of the item. Because temperatures in the engine bay will exceed 250°F and because it will require a considerable amount of time and money to develop equipment to withstand temperatures over 250°F, the need now for artificial cooling is mandatory in order to get satisfactory functioning systems.

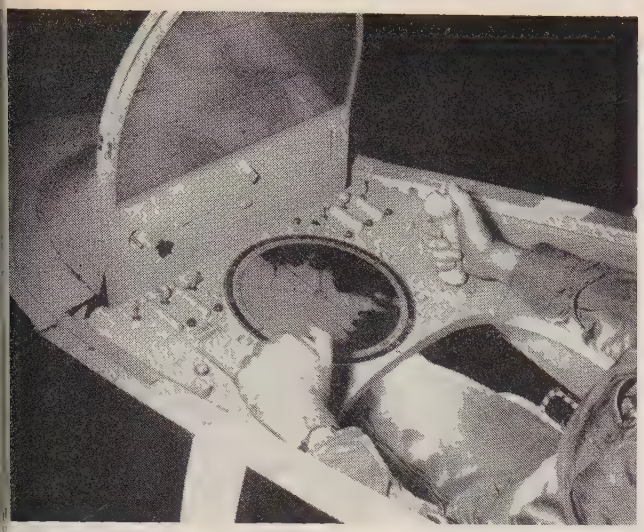
The need for cooling of the fuel and oil or isolation from the heat sources is equally imperative. Oils in the lubrication system are subjected to a tremendous heat load because of intimate contact with the physical engine parts. Synthetic oils (MIL-L-7808) can operate satisfactorily at temperatures as high as 400°F. To maintain temperatures below this level, the engine vendors have resorted to conventional air to oil coolers and fuel to oil heat exchangers. JP-4 fuel is commonly used for the current gas-turbine engine. When it is subjected to high temperatures and at reduced pressures, as it would at altitude, vaporization of the fuel is rapid. This is shown in *Figures 3* and *4*. *Figure 3* shows the results of a study using a hypothetical aircraft having a completely uniform initial temperature of 100°F, to determine how the rate of fuel evaporation would be effected by insulation and pressurization. The aircraft was to fly on a prescribed mission at Mach 2 at 40,000 to 50,000 ft. *Figure 4* shows the advantages to be gained by allowing a small amount of loss and the pressures required to maintain a limit of loss at various temperatures of the fuel.

One method of cooling, utilized to date, has been the expansion air turbine which is relatively light for its capacity and can provide limited cooling which will suffice for most current installations. Another method, on a limited scale, has been the use of evaporation cooling with water. To understand the heat load on supersonic aircraft, it has been estimated that a fighter aircraft at Mach 3 develops heat at a rate which would melt a ton of ice per minute. At Mach 4, sustained flight would raise the aircraft temperature to 1,000°F, without refrigeration.

The horsepower required to pump air through the engine bay to cool structure and components represents a considerable amount of energy. This must be considered to be lost, unless there is some increase of momentum of the air, with the heat addition, which can be utilized for propulsion. The use of insulation blankets in lieu of shrouds reduces pumping losses and many airframe vendors are enthusiastically welcoming its utilization for high-speed aircraft. The main disadvantage to the use of any type of insulation is that it contains the heat within the enveloped component and raises the temperature above that to which it would otherwise be subjected without the insulation. Some of the engine companies are willing to permit the blanketing of their engines; however, most of them will not allow any insulation to be installed and they insist on a certain percent of the engine air-flow over the engine exterior surfaces for cooling.

There is a great deal of objection to the flow losses created by the impedimenta located in the engine-bay cooling-air path. The major flow barrier is the fireseal which separates the compressor and the combustion zones of the engine. Other barriers, such as the plumbing, and protuberances from the engine, such as the accessories, cause losses of a lesser degree. One purpose of the fireseal is to separate the zones containing fuel lines and the combustion zone which generates temperatures sufficiently high to ignite the fuel. Another purpose is to prevent the travel of fire from one zone to another. There has been some question as to whether or not the value of the firewall is sufficient to warrant its installation when it causes a high cooling-air pumping loss. This method requires a judicious examination to determine whether there is a better method of accomplishing satisfactory cooling and still retain the same degree of safety now realized with the conventional fireseal.

One program which the Air Force, NACA and Industry have been developing is not related to the continuous cooling problem but is related to the rapid cooling of hot parts to prevent crash fires resulting from the intimate contact of fuel and the hot engine surfaces. (*Continued on page* 44)



ANEL *for tomorrow features horizontal and vertical flat-plate TV ubes, replacing the conventional dials as shown in panels below*

Engineered for Tomorrow

Human Engineering is force behind development of new and simplified jet instrument panel

The amazingly simplified jet-fighter instrument panel designed for the Navy by Douglas Aircraft and associated companies has focused attention on a relatively new and little publicized branch of aviation science—human engineering.

As defined by Lieut. Comdr. George W. Hoover of the Office of Naval Research, a recognized leader in this field, human engineering means engineering for human use (SKYWAYS, *April, 1954*). It takes into account human capabilities and limitations and serves to integrate man, machine and environment for the most efficient operation. The results include increased safety, reduction in production, maintenance and redesign costs, and a savings in training time of close to 75%.

In its practical application to the cockpit of tomorrow's supersonic jet fighter aircraft, human engineering has involved an instrument panel configuration which presents information to the pilot via two TV tubes rather than a multitude of conventional dials. This radical change represents the human engineer's data presentation theory that the fewer numbers the pilot has to see and remember the fewer chances he has of making an error. It also represents the thinking that a picture is much more readily comprehended than the dials of a conventional instrument panel.

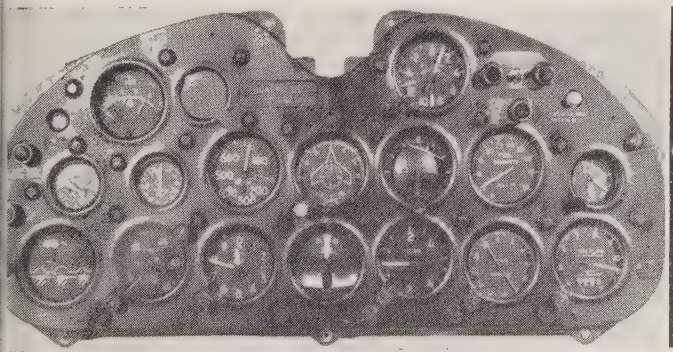
The new instrument panel, the result of more than 10 years of study and experimentation by the Navy, is part of a long-range program to reduce the control system to two basic items—a control stick and a throttle—and to substitute qualitative indication for quantitative indication in instrumentation. The human engineer believes that the elimination of numerical values in cockpit dial indication is valid because it is unnecessary for a pilot to memorize such items in order to determine the condition of his particular operation. Actual quantity of, say, fuel in pounds or gallons is of little consequence to the aircraft operator except for use as an index. The new cockpit, therefore, is designed to show condition rather than exact numerical values.

For example, there is no airspeed indicator in the new cockpit. However, the human engineer has placed a shallow rectangle on the flat-plate vertical TV tube to show the pilot his speed range. The extreme right side of the rectangle is simply labeled "maximum speed."

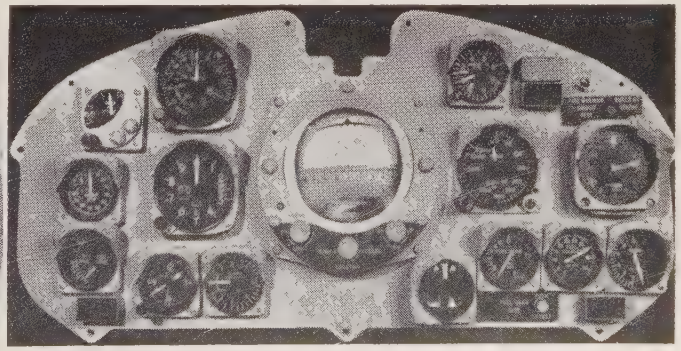
Fuel in today's conception of the ultimate in cockpit configuration is displayed in miles, rather than in pounds or gallons. This information is superimposed on a round-plate TV tube mounted horizontally in front of the pilot. Two arms extend from the center of the screen like the hands on a clock, one pointing to "fuel remaining" and the other to "miles to base." Distance is marked off in 250-mile segments.

The outer rim of the horizontal TV tube is a compass.

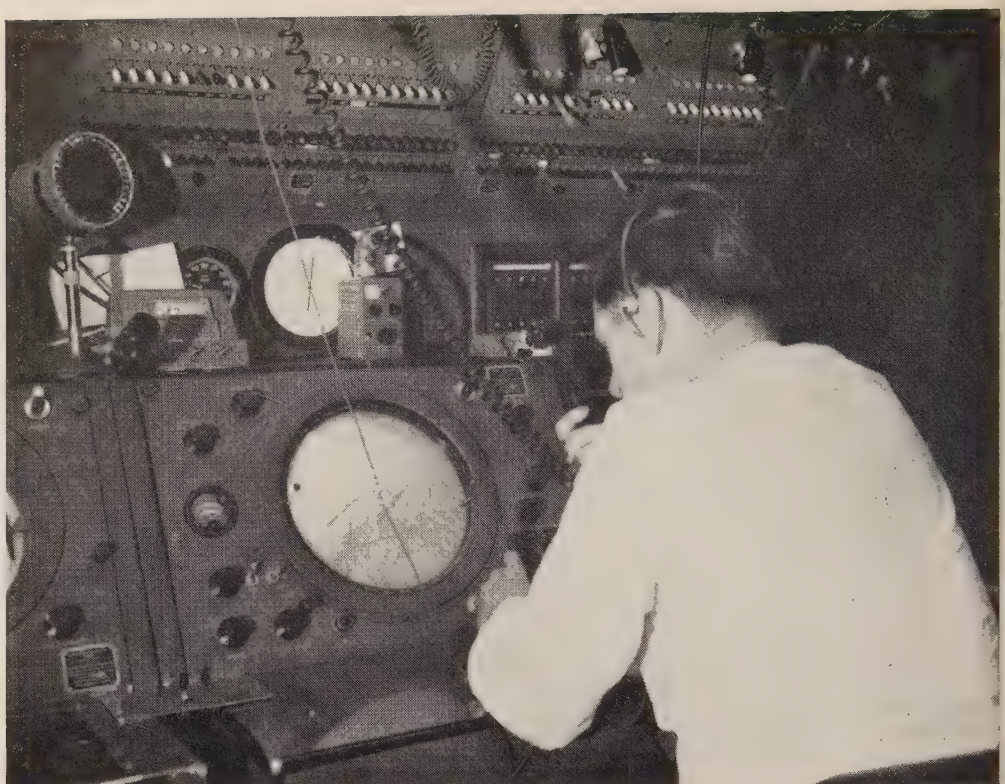
The new-type transparent TV tube mounted vertically in front of the pilot displays altitude, speed and attitude. Such physical features as mountains would be depicted artificially on the tube, which also would supply pitch, roll and yaw information. Instead of an actual picture of the physical features of the earth, the pilot would see an analogy of the world he (*Continued on page* 42)



NSTRUMENT PANEL *of today's jet plane has 16 dials, innumerable erniers, knobs and toggles requiring pilot's constant attention*



INTERIM PANEL *now being flight tested by ONR and BuAer offers integrated instrumentation. Next step is the TV tube configuration*



AIRPORT *surveillance radar is in full and successful operation at certain key airports in the U.S. This one (right) is in the IFR Room at New York International Airport (Idlewild). ASR's application to aircraft spacing under IFR conditions should be successful*

Aircraft Spacing under IFR Conditions

by K. D. Swartzel
Chief, Navigation Dept.
Lear Research & Development Div.

The Air Traffic Control system (ATC) operates to insure separation of aircraft in instrument weather. The prime objective, of course, is the prevention of collision. This is accomplished by regularizing and controlling the take-off times, and the courses and altitudes to be flown for every aircraft operating on an IFR flight plan. Progress of the flights is monitored by requiring all aircraft to report by radio at specified enroute checkpoints. A team of operators, using equipment to help them keep "score," maintains vigilance to insure that the flights are directed so that they operate with safe spacings.

That the results have been successful is indicated by the fact that there are no instances on record of fatal mid-air collision between aircraft on instrument flight where *all participants were controlled by ATC.* Credit for this achievement is due not only to the adequacy of the system itself and the staff which operates it, but also to the cooperation of the pilots who are responsible for taking pains to report in, correctly and on schedule. Let me also include a plea for continued effective work and for further improvement of the IFR operations.

With the possible exception of the surveillance radars now in use at certain airports, there is no operational means of measurement of the adequacy, and possibly over-adequacy, of the space margins which actually are experienced in ATC-controlled flight. We do not really know exactly how safe, or how over-safe, the system is. We have only bits and pieces of data to go on, and such data may be misleading. For instance, now and then we hear of a pilot receiving quite a shock when the soup in which he is flying thins out enough to disclose another aircraft uncomfortably close on his wing. Such incidents (happily, they are rare) can result only from some remaining inadequacy in the system or, perhaps, a temporary breakdown of the system itself as the result of human failure. The system, of course, is intended to prevent such hazards. When they do happen, the cause probably can be ascertained, especially since the sincere and honest cooperation of all persons concerned is usually available. Modification of procedures to further reduce incidents of collision threats can be made. The fact that such close calls are more likely to occur in the congested areas near air terminals is important, but they also could occur enroute.

For each such rare and unusual case where a "near-miss" in the soup has been visibly noted, it is uncomfortable to note that there may be threats that go completely unnoted because of poor or zero visibility and because the flight crews may have been busy looking at the gauges at the one moment when such a threat might have been noticed. Audible detection (*i.e.*, hearing the engines of the nearby aircraft) is of little or no value in the presence of the high noise level in a typical cockpit.

Thus, we lack proof that the margins are flawless, and we have some minimal evidence that they may not be completely safe under some circumstances. On the other hand, those few system failures (or near-misses) on record may be the result of shortcomings in the actual method of application of the system. If such shortcomings could be isolated, it probably would be easy to apply corrective modification to the flight regulations to eliminate them in the future.

In a happier vein, let us note that the margins actually may be, and probably are, more conservative than they need be for safe instrument flight. If this is the case, it means that although the airspace is not being used to its full capability, our instrument operations are truly safe.

As long as airport acceptance rates are relatively low, as they are at the present time, it may not be necessary or even desirable to improve this airspace utilization enroute. At some future date, however, higher acceptance rates will be achieved at the airports, and then, with the rapidly expanding air traffic, the enroute traffic capability of the airways may become the bottleneck. The demands on the commodity called airspace may become very heavy, creating problems not unlike those faced by the FCC which must attempt to ring every ounce of utility out of the radio frequency spectrum. When this situation arises in the field of air traffic, it will be necessary to optimize the proportioning of spatial separation between aircraft in order to secure maximum utilization of the air with safety. No longer can we afford to be lavish, opening the margins without restraint. This problem will be met despite advances in the science of navigation and control. Undoubtedly, such advances will be made as a matter of course, and will themselves contribute to the effectiveness of airspace utilization.

We will be faced with the problem of determining, with precision, just how much reduction of flight separation of aircraft is possible without any compromise of safety. We must be correct because the stakes are high.

The problem can be defined as one of determining, either by analytical means or by direct measurement, the actual magnitude of the space margins under specified control-system conditions on a continuing basis, either with respect to future proposed systems or for systems in current use.

It is the purpose of this paper to consider what means we have for securing knowledge of space margins on which to base our decisions as we contemplate and accept or reject new traffic control systems or make changes in the old.

For new systems which have not yet been tried out, one method is through analytical study since measurement cannot readily be made. This means a careful paper study and analysis, which is exactly the method used in the past. A supplementary technique, not used before to my knowledge, is study by means of an analog, or replica, of the actual system. This can be set up in the laboratory, and might be done by using computer techniques which have been well developed in the last few years. I would like to put this suggestion out for future contemplation. Analog (and digital) computer techniques have become powerful tools for engineering sciences and for industry, and they may be of great value in the study and continuing solution of the air traffic control problem.

The other method is a resolution based on experience with actual flights, utilizing measurement of flight paths as a function of time, and under controlled conditions. This method does not have the shortcomings of the analytical method that may not yield a close approach to the optimum answer, not being based on experimental observation of the actual system. Therefore, I would like to discuss some of the difficulties one is confronted with in the experimental approach to the problem, and to suggest a possible means of instrumentation for the actual observation of flight separation margins in practice. My discussion is, of course, tempered by a recognition of the extreme complexity of the problem.

Secure decisions for the minimizing of the traffic control margins must be based on a large number of observations made in flight under controlled circumstances. Through such observations the validity of assumptions made in the study can be verified. Since verification has to be made on a statistical basis, the number of observations must be large, covering an extended period, in order that the data be representative. Because of this factor it is apparent that the equipment should be as nearly automatic in its operation as possible.

Two methods of instrumentation for observation of flight separation are apparent. One is ground-based radar, and the other is instrumentation within the aircraft.

We already have a number of surveillance radars in full and successful operation at certain key airports in the U. S. Their application to the problem at hand should be relatively successful except for certain shortcomings. One shortcoming is their relatively small areas of coverage, since they are used in concentrated areas near major airports, and a sampling of enroute traffic would not be available through them.

Utilization of these radars would be somewhat difficult since their greatest utility to ATC is when the soup is the

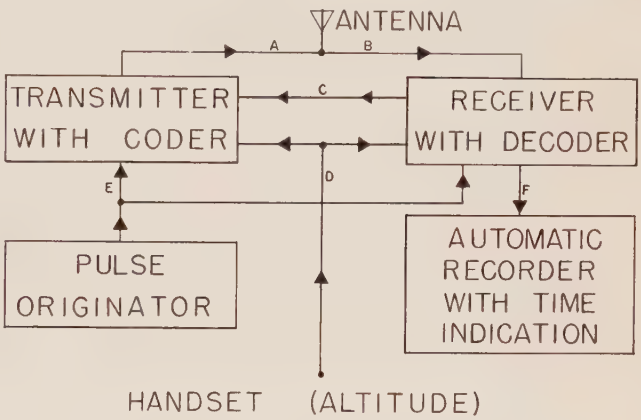


FIGURE 1—*Flight Spacing Monitor*

thickest and ATC personnel are too busy to make observations requiring continuous watching of specific aircraft. A separate display, operating in parallel and placed out of the way of the ATC personnel, would have to be used.

This separate repeater scope would require at least one person assigned full time during periods of inclement weather. His responsibility would be to watch any flight paths that might approach one another. He would have to have some means of resolving altitude separation in order to recognize instances of close, unsafe approach. He would have a notebook or a magnetic recorder in order to make entries with enough circumstantial detail to permit later resolution of the information.

The value of the radar method is greatly diminished by the fact that the approach control personnel are on the look-out for exactly the same sort of crossing-path circumstances, and are responsible for avoiding materialization of collision threats through their own alertness in transmitting commands where required. Much more valuable would be data pertaining to circumstances that are unmonitored other than by flight path and holding pattern directions.

The alternate means which I would like to suggest is fairly self-evident and has the advantage of completely automatic operation and of functioning equally well under the critical circumstances where radar monitor is not in operation. The method has the disadvantages of relatively high expense and maintenance, and some encroachment on payload. A by-product which could be gained might be an automatic collision-threat alarm.

This method requires the installation of a transponding radar beacon in at least 50% of the aircraft operating in or expected to operate in (*Continued on page 37*)

APPROACH LIGHTING *discussion brought together representatives of USAF, Navy, ALPA, ATA, CAA and airlines. Those participating were (left to right) Capt. John Gill, Eastern Air Lines; Col. J. Francis Taylor Jr, ANDB; Amos Lewis, USN; Dave Little, American Airlines; George Clement, USAF; Capt. J. D. Smith, Air Line Pilots Assn; Art Jenks, CAA; Capt. Ernie Cutrell, American Airlines; Frank P. Brady, Air Transport Assn; Robert J. Alpher, CAA; Joseph D. Blatt, Assistant Administrator, CAA; and Richard M. Egan, Structural Concrete Products Corp, U.S. representative for the Dutch company manufacturing Elfaka lights*

SKYWAYS FLIGHT OPERATIONS ROUND TABLE

MARCH 1955 *Statler Hotel, Washington, D. C.*

Standardization of Approach Lighting

Part 1: Approach Lighting discussion discloses reasons for disagreement on acceptance of single system, agreement on need for full-scale flush-light tests

Moderator J. D. Smith (*Regional Safety Chairman, ALPA*): "To give SKYWAYS' readers a little background on the problem under discussion today, let's review the present status of approach lighting.

"After years of study and test, we now have available three systems of approach lighting which are accepted criteria of the CAA. The Type A system is acceptable to the commercial interests but not to the military; Type B configuration is a military system not well thought of by the commercial interests; and Type C is primarily a Navy installation and does not appear at civil airports. Type A is standard for civil airports, and Type B for military airports or airports having a designated overrun area.

"The current approach-lighting problem arises from the fact that where we have joint use of airports by both military and commercial interests, an overrun area is designated for military operations, and therefore we have, in effect, a Type B configuration being implemented at all joint-use fields. Because of this, the commercial interests visualize only Type B configurations eventually installed. Consequently, we have the commercial operators utilizing lower minimums and being forced to operate into airports where a system considered unsatisfactory exists.

"*With that as the background, Mr. Clement, would you lead off the discussion for us?*"

George K. Clement (*Chief, Visual Aids to Air Navigation, Engineering Branch, USAF*): "I, as an individual cannot obligate the USAF. Therefore, my remarks must be as an engineer. The Air Force clearly understands the value of uniformity and the advantages of the use of a single configuration in approach lighting. To achieve this end, the USAF is willing to make concessions but it is unwilling to compromise on any point that would produce a configuration unusable by its aircraft or which, due to the presence of equipment in certain positions, would constitute a hazard.

"Personally, I feel it is deplorable that we must consider more than one approach-lighting configuration. The three configurations presently adopted actually are only two, in that Configuration B is a modification of Configuration A and is used only when certain conditions prevail. The Air Force has taken action to convert all existing approach-lighting systems to that standard. However, the rapidity with which these changes will be made depends upon the availability of funds for that purpose."

J. D. Smith: *"From a pilot's standpoint, standardization is the thing that is bothering us. For example, the Air Force has been installing approach lights at Youngstown (Ohio) which are not consistent with any criteria. The Air Force did the same thing at Niagara Falls and that installation is different from the one at Youngstown. Right now the Air Force is installing a system of approach lights at Pittsburgh, and it is a modified version of still another criteria.*

"Speaking for the pilot who has to continually make 200 and ½ approaches at every airport, ALPA questions the thinking that puts a pilot in that position all the time.

"Frank Brady, let's have some comment from you relative to the need for a standard visual aid that pilots can instantly recognize when breaking out underneath the overcast."

Frank B. Brady (*Project Engineer, ATA*): "Right now approach-lighting systems are a sort of hodge-podge. According to a recent check, we have commissioned and in operation four slopeline systems, 19 high-intensity left-hand row systems, four standard centerline systems, and four Air Force overrun systems. In addition to these, we have 73 Neon left-hand row systems and one Neon center-row system.

"ATA believes priority should be given to changing those non-standard systems to standard, rather than adding new approach-light systems at locations where they are not now available."

J. D. Smith: *"John Gill, you've done a lot of work on this. What is your opinion?"*

Capt. John Gill (*Chief Pilot, Eastern Air Lines*): "I'm in complete agreement with Mr. Brady's suggestion for a priority for changing non-standard systems to standard. Granted the standard isn't all that we'd like it to be at the present time, it does enable us to close on and hold a centerline. We know that we need a minimum of 3,000 ft of centerline, and we know that to close on and hold a centerline requires a bar-type lighting of sufficient width to give us adequate roll guidance. If you haven't roll guidance, you just can't close on and hold a centerline properly.

"Where we diverge in the standard is in the need of the military for the undershoot area. That is a big problem in the jet-type operation. The clean, fast airplane uses up all its runway, and in his anxiety to take advantage of all the runway, the pilot occasionally will undershoot. They are having the same problem with jets in England today. The airlines had the problem of undershoot at one time, but it no longer exists at the airports having the centerline configuration. Tire marks indicate all airliners bang the runway at the same place, plus or minus very little. There is no such thing as an undershoot because there is no invitation to land.

"The overrun or undershoot area must be completely unobstructed by anything that could be construed as a hazard or obstacle. Obviously, if that area must be free and clear, the only thing that can be done is to light the outside edges. I think we all are well aware of the bad features of two-row lighting (*i.e.*, the inability to distinguish between individual rows of two-row lighting, even though the rows are supposedly adequately marked in the drawings, etc., and the fact that there is no centerline with two rows). At one of the airports in the Far East, the Air Force pilots call it 'the floating runway.' You just float around; there is no centerline.

"The main problem, however, lies on the runway. We have found that where we do have an adequate approach-light system, such as at Newark Airport (N. J.), we have ceased to have a problem in the approach zone.

"Even with the best runway lighting known today, we have found that the old 'black hole' effect still exists under certain conditions. The obvious need is to carry the centerline lights right down the runway; in the approach zone and down the runway too.

"If we need lighting on the runway and the military requires it in the undershoot area, then all we have to do is to have the same thing in the underrun area as we need on the runway. The answer to both problems is some type of flush lighting."

Arthur E. Jenks (*Chief, Flight In-*

ROUND TABLE PARTICIPANTS

J. D. SMITH (above), Moderator of the discussion, has been Capital Airlines' captain since 1945. He also is Regional Safety Chairman of Air Line Pilots Assn.

RICHARD W. EGAN is Vice President of Structural Concrete Products Corporation, U. S. representatives of the Dutch concern that manufactures Elfaka lights

JOSEPH D. BLATT, Assistant Administrator, joined the CAA in 1937; has been active in coordinating policies of U. S. Govt's ACC, and in the ICAO at Montreal.

AMOS L. LEWIS, Acting Head, Visual Landing Aids, BuAer, was Navy's first full-time airfield lighting engineer; he won Navy Award for Visual Landing Aids work.

E. A. CUTRELL has been American Airlines pilot since 1934; was ALPA rep on ANC during Arcata tests and opposed adoption of Slopeline Approach Light System.

JOHN F. GILL, Chief Pilot, Eastern Region, for Eastern Air Lines, joined Eastern in 1930, became Chief Pilot in 1940. He began commercial flying in June, 1926.

DAVID S. LITTLE, Supt. Navigation Aids & Electronics, American Airlines, has been a licensed (ATR) commercial pilot since 1927; is also Captain, USNR.

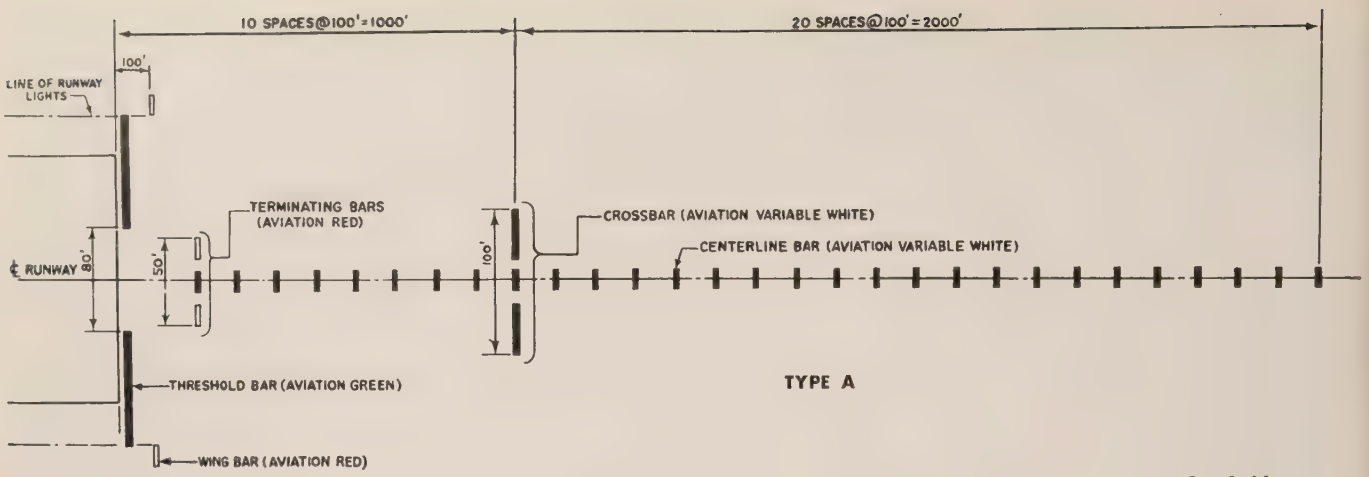
COL. J. FRANCIS TAYLOR JR, was appointed Director, Air Navigation Development Board, in 1954. He graduated Randolph, Kelly Fields; attended Air War College.

ROBERT J. ALPHER, Deputy Chief, Plant and Structures Branch, CAA, graduated in civil engineering from Geo. Washington University in '31; joined CAA, '37.

FRANK B. BRADY, Project Engineer, ATA, has done extensive development, evaluation work on electronic and visual aids for 15 years; participated in Arcata tests.

GEORGE K. CLEMENT, Chief, Visual Aids to Air Navigation, USAF, organized that section in 1940; has been associated with standardization program for some time.

ARTHUR E. JENKS earned his Air Transport Rating in 1932. He joined CAA in 1940 as Aeronautical Inspector; became Chief, Flight Inspection, CAA, in 1950.



TYPE A *configuration shows centerline lighting continued through overrun area from 1,000 ft out to runway threshold*

spection Div., CAA): "One of our big problems is the technical know-how on approach lights. If you were to survey that know-how in the U.S., you'd find 50% of it right here in this room talking into SKYWAYS' tape recorder. And that applies not only to lights but to other things as well. To me, the lights, the visual aid portion, are just another headache in the approach problem.

"What Johnny Gill said about closing on a centerline is true, and until we can arrive at the point of automatic landings, we can't do without visual aids. That applies to take-offs as well as landings. I've flown out of several military bases, and it's quite a shock at some fields to go sizzling out of a brightly lighted runway and into blackness that is total obscurity. It is strictly an instrument operation.

"What we are wrestling with now in the approach-lighting problem is the time factor. That last 15 seconds of the approach is what counts because that's where the transition from IFR to VFR takes place. As speeds go up, that thousand feet of lights we're talking about amounts to just 5 seconds. If that 5 seconds occurs at a critical portion, you've had it!

"In discussing the overrun, the black hole or whatever you want to call it, if you have sufficient visibility to size up the situation, then the approach is no particular problem. But if you have a little weather that obscures the guidance of the centerline and you plop into that framed area, you're in trouble with some types of airplanes, particularly those with fairly high wing loadings. You slow to perhaps 15 mph over stalling speed when you come down a glide-slope, and you're really operating in a marginal flight condition.

"Before going any deeper into this discussion, I'd like to report on a bit of paper work I've been doing here. The using public of all these facilities amounts to about .001% of our total population. That's why we don't have much of a voice in this matter and why what voice we have isn't listened to. You can apply that to any operating problem in instrument flight, particularly where it involves visual aids."

J. D. Smith: "*While the pilots may account for only a small percentage of the population, isn't it true that the number of people benefiting from proper and standardized approach lighting runs into the millions?*"

Art Jenks: "Definitely. There were 33 million passengers last year."

J. D. Smith: "*Ernie Cutrell, you've been a pilot representative on this work for some time. Would you comment on this visual aids problem and the transition the pilot must make?*"

Capt. E. A. Cutrell (*American Airlines*): "Actually, I'm dumbfounded that by now we haven't more aids to benefit the transition from instrument to visual flight!

"We ought to look at visual aids from the standpoint of having two-way approaches at the principal major terminals. At no airport in the U.S. do we have a two-directional ILS with approach lights. Canada has four-way approaches at Montreal and Toronto, while here in the U.S. at an airport like Idlewild we have only a one-direction approach to the #4 runway. An example of the results of that, was the recent Italian Airlines' accident. The pilot made one attempt on the back course, then failed on the fourth approach to the #4 runway. Granted, the conditions were pretty rough; I believe the tailwind component was 30 knots at 1,000 ft.

"The visual aids we need most, in two directions, are the approach lights adopted by IATA and ICAO. I think even Al Lewis and George Clement are convinced it's the best system at this time."

George Clement: "I wouldn't say I'm convinced the centerline system is the best, but I would say I'm convinced the only way to obtain over-all safety is by the use of a *single* system."

Art Jenks: "Certainly, we've explored the whole situation enough to have arrived at a standard, and that standard is the Type A configuration. It's what the pilot needs and wants. The A system also includes the condensor discharge lights, and if we can get the complete A system installed, proper runway lighting and marking, we're really in business."

Col. J. Francis Taylor Jr. (*Director, ANDB*): "Perhaps this problem needs resolution at the policy level. The new Air Navigation Development Board is certainly seeking means by which more efficient and less costly air operations can be assured through standardization. Mr. Quarles, Chairman of the Board; Assistant Secretary Murray, Commerce; Assistant Secretary Smith, Navy; Mr. Gardner of the Air Force, and General Corderman of the Army have expressed unanimous agreement in the need for a Common System. Maybe approach lighting should be included as a part of the Common System. If we are to have a system which is truly common to both civil and military interests, it should include the lighting configuration the pilot uses as one of his aids to final approach and landing.

"We certainly cannot afford to neglect the opportunity for joint civil/military use of airports, and this use seems to demand the working out of a common understanding on approach lighting. I believe the problem should be presented to ANDB for its consideration."

George K. Clement: "Col. Taylor, this proposition of standardization of visual aids to air navigation was presented to ANDB some time ago, and ANDB officially stated it had no interest because it already had been developed!"

Col. Taylor: "I realize that, but it appears that changes in circumstances have made it advisable to review that

particular decision.

"To summarize my position, I think the lighting problem is heading for a dispute of the same order as the one VOR/DME and TACAN are presently in. ANDB is in the process of resolving this problem by selecting one of these systems for Common use. The approach lighting problem should be subjected to the same action to prevent further expenditures on nonstandard lighting systems, for both safety and economy's sake."

Capt. Gill: "Frankly, gentlemen, the lack of realization of the necessity for adequate visual aids is alarming. I find in high places, even among the airlines, a complete lack of understanding of the need for these visual aids.

"There also is complete acceptance in high places of the one-direction approach, whereas pilots know that an approach must be at least two directional. England has it; Canada has it, but the U.S. does not have it. If the importance of visual aids was known or understood, I'm sure it would be at the top of the priority list."

J. D. Smith: "*Mr. Blatt, would you outline for us what criteria CAA would use in determining whether or not Type A or Type B configuration would be implemented at an airport?*"

Joseph D. Blatt (*Asst Administrator, CAA*): "Before I go into that, J. D., I'd like to cover a couple of other points.

"First, I'd like to say that I agree with many of the facts brought out here. One of our greatest weaknesses has been that we've talked about approach lights for 15 years, but have done nothing much about it. Perhaps the more we talk, the less we convince people that we know what we want.

"Some time ago, as chairman of the ACC's subcommittee on aerodromes, air routes and ground aids, I directed the development of a national standard for approach lights. Of necessity, a national standard must be a minimum standard on which you get a maximum amount of agreement from all interested agencies. We agreed on the basic concepts that Johnny Gill described to you. We wanted an approach light lane to give us guidance, and we agreed that centerline guidance was vital. All three configurations, A, B and C, provide centerline guidance, but whether the centerline guidance is adequate or not in those three configurations is subject to argument. However, the basic part of all three systems described in the national standard is the centerline.

"The national standard also requires a 1,000-ft crossbar to give the pilot distance and touchdown information. The centerline and the 1,000-ft crossbars are integral parts of A, B, and C. We could not get complete agreement on subsidiary lighting facilities, so the national standard does not require them in any of the systems.

"The subject of implementing more than one approach has been brought up. Instead of worrying about where we are going to implement two approaches, three or maybe four, let's get acceptance of the standard, and then do the implementing.

"The controversy, if there is one, that exists between the military and the civil users of the approach guide system should not be presented to ANDB or any other body because it would mean more years of discussing considerations already evaluated just to reach the present status, with no better prospect of accelerated implementation. In my opinion, we are so close to agreement now that it would be dangerous to become involved in another round of exploratory analysis and discussion.

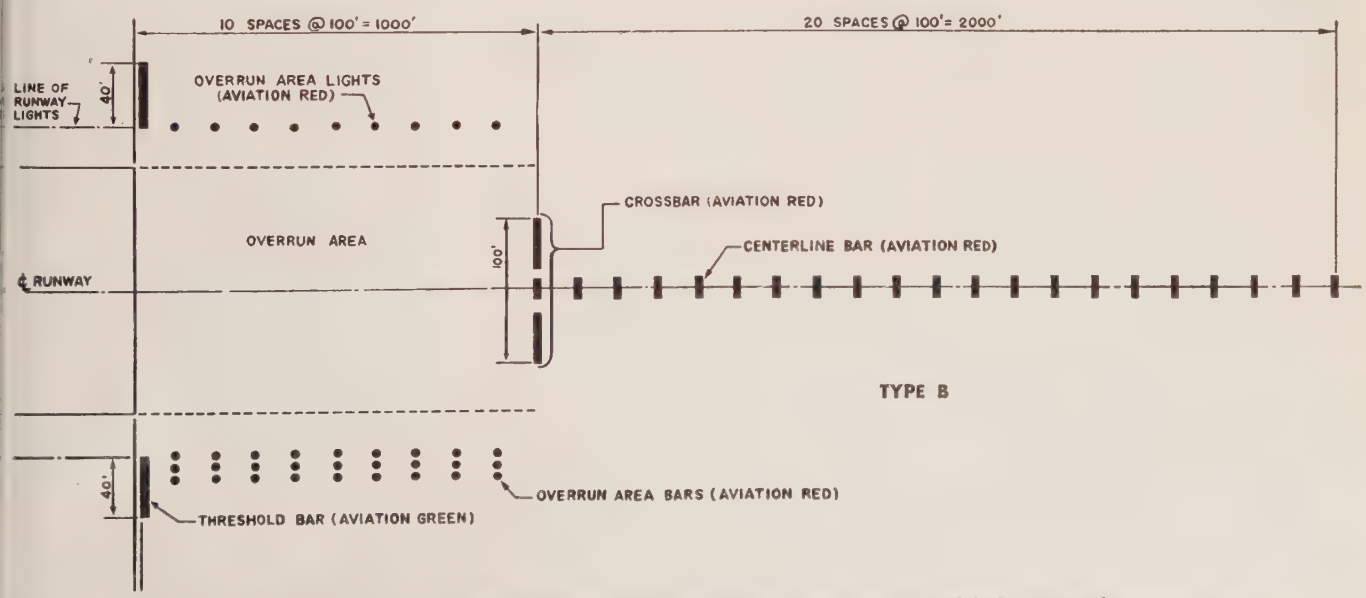
"At the present time, the Air Force and the CAA are in complete agreement except for the last 1,000 ft. The AF requires the obstruction-free undershoot area. The CAA recognizes and appreciates that requirement, but how can we overcome it and meet the civil desire for centerline guidance right down to the threshold? The obvious answer is the development of an adequate flush-type light.

"The Air Force and the CAA presently are undertaking an experimental installation, and by it we hope to prove that an adequate flush-type light can be made available. We also hope to prove that a single configuration will meet all the objectives of both the Air Force and the CAA.

"I'm firmly convinced that if we can pursue this project to completion without interference, we will have the uniform standard that you gentlemen want.

"To answer your question, J. D., regarding the criteria for determining whether a Type A or Type B installation should be made, the CAA issued TSO N24 which sets forth the approach lights policy of the CAA. The civil standard for civil airports is Configuration A. However, where an overrun area is required, Configuration B is permitted. We hope this experimental installation I mentioned will permit the acceptance of a single configuration—and that the Type A.

(*Continued on page* 36)



TYPE B *configuration breaks off centerline lighting at 1,000-ft mark and employs sidelights to mark overrun area*

SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS

LEARSTARS, *recently type-certificated by CAA in "4b" Transport Category, are in volume production at Santa Monica. Production for 1955 calls for a rate of two units per month*

Flight Safety, Inc. to Get New Link Flight Translator

New York, N.Y. Link Aviation and Flight Safety, Inc., joined forces in the development of a twin-engine, two-place procedures and navigational flight trainer which will be "in operation" at Flight Safety, Inc., sometime early next year.

Designed and built by Link to specifications established by Flight Safety, Inc., the new trainer (designated E-600) will simulate two complete and independent powerplants found in a typical twin-engine aircraft. Each simulated engine will operate as an entity in itself and will have its own complete set of instruments and controls. This feature makes possible the simulation of asymmetrical engine operation and its effect on aircraft performance.

The E-600's complete radio facilities provide for the precise simulation of the complex radio problems facing today's professional business pilots at busy airports around the country. Pilots can receive as many as four radio stations simultaneously in the E-600, thus making possible a thorough pilot drill on radio aids and procedures including approaches, let-downs and latest ATC procedures.

The trainer (called a Flight Translator) is composed of a cockpit section, an operator's or instructor's panel, and steel cabinets housing the computer mechanisms upon which proper simulation depends. The two-place cockpit contains all the normal flight instruments, for both pilot and copilot, and a complete set of engine instruments. The instructor's area includes all the controls necessary to set up a training "flight" to any part of the world and to make necessary adjustments or settings during the progress of the "flight." The trainer also is equipped to train crews to cope with such emergency situations as partial or complete power failure, engine fire, radio or instrument failures, ice, etc.

Flight Safety, Inc. is the organization that pioneered advanced refresher and specialized training for professional pilots of business aircraft. The firm has since expanded its activities to include an advisory and consultation program designed to help industries in the selection, operation, utilization and maintenance of business aircraft. FS, Inc. is located at LaGuardia Airport.

Socony-Vacuum Names Morris Head of Aircraft Operations

New York, N.Y. Charles E. Morris has been appointed manager of aircraft operations of Socony-Vacuum Oil Co., Inc. Mr. Morris has been with Socony-Vacuum since 1951. He served as captain pilot of one of the company DC-3's before being appointed to his present position in charge of company aircraft. Mr. Morris flew with Pan American and All American airlines before joining Socony-Vac and he served as a B-24 pilot during World War II. He was discharged as a lieutenant colonel.

CAA Certificates Learstar in "4b" Transport Category

Santa Monica, Calif. The *Learstar,* Lear, Incorporated's high-performance business airplane, has been certificated by the CAA in the "4b" Transport Category. During more than 160 flying hours, the *Learstar's* performance met the standards under which such airliners as the DC-7 and the *Super Constellation* are certificated. Thus, the *Learstar* becomes the only airplane in production today that is specifically designed for private use, yet is fully licensed for operation as a scheduled airliner.

Trip times logged during recent cross-country flights averaged 10% less time between points than first-class airline schedules for the same trips. For example, Los Angeles to Dallas—4.16 hrs; Dallas to Washington, D.C.—3.58 hrs; Los Angeles to West Palm Beach, Fla.—7.44 hrs. On all flights 55% power was used for cruising and all flights were non-stop.

Two prototype *Learstars* have been completed and 10 more are in production. Deliveries are scheduled at a rate of two a month. Companies listed as having placed firm orders for *Learstars* include British American Oil Co., Ltd., Toronto; Charles B. Wrightsman, Palm Beach, Fla.; Chance Vought Aircraft, Dallas; Johnson & Johnson, New Brunswick, N.J.; and Burroughs Corporation, Detroit, Mich.

Outer Wing Trade Plan Ups DC-3 Gas Capacity 400 Gals

Los Angeles, Calif. Thanks to an innovation introduced by the Aviation Service Division of The Garrett Corporation, owners of DC-3 aircraft can now trade in the outer wings of their planes for a pair that will hold 400 extra gallons of gasoline. Wings held in storage and exchanged make possible immediate package installation of the additional fuel tanks, whereas installation formerly took several weeks after an order was placed. By trading in the old wings for new ones, each of which contains two 100-gallon fuel cells, DC-3 owners can increase their aircraft's range by some 800 miles. Wings thus traded are immediately equipped with new tanks to await the next DC-3 change-over customer.

Blink-R Light Flasher Gets CAA TSO Approval

Teterboro N.J. The Blink-R Navigation Light Flasher, distributed by Van Dusen Aircraft Supplies and already in service on many aircraft, has received the CAA's TSO (Technical Service Order) approval. The Flasher is one of the first single-circuit position light flashers to be CAA certificated for installation on non-carrier type aircraft. The Blink-R is standard equipment on the Cessna L-19, military version of the 190, the de Havilland *Beaver,* and the new Cessna 310.

The unit weighs 13 ounces and is easily installed anywhere along the plane's navigation light circuit. It has a rate of 60 to 120 flashes per minute, is fully shielded and contains a radio interference filter. The timing mechanism is not a part of the light circuit and in the event of any failure of the mechanism the lights go to a "steady-on" condition. The Blink-R operates on either a 12- or 24-volt electrical system and has a lamp load capacity of 5 amps.

Anaconda Copper Buys Bell Copter for Uranium Survey

Grant, New Mexico. Anaconda Copper Mining Company now combs the rugged Colorado Plateau region for uranium with a Model 47G helicopter equipped with hydraulic boost control power steering. Armed with a scintillometer, the Bell 47G operates out of Anaconda headquarters in Grant, retracing surveys made earlier by conventional airplanes.

According to Jack Knaebel, general manager of the New Mexico operation, the recordings taken from the copter are more detailed and precise than those made from fixed-wing aircraft. The helicopter's ability to fly low and slow brings the sensitive scintillometer into play just a few feet above the ground, in contrast to the 100-ft altitude necessary when the survey is done by conventional aircraft at speeds of 65 or 75 mph.

In a recent 21-day trial period, the 200-hp Bell copter logged more than 70 flight hours over known anomalies to check its utility under controlled conditions. The results of this trial convinced Anaconda officials that the helicopter should be added to its prospecting "tool kit."

Although purchased primarily for use as a mobile scintillometer, the 47G has proved useful in transporting engineers and technicians to outlying regions.

The "power steering" system installed in this Model 47G provides the pilot with hydraulic assistance for smoother operation and superior maneuverability, necessary for the turbulent flight conditions that prevail over the Colorado Plateau.

FAIRCHILD'S *Richard A. Henson, Manager of Flight Test, recently took delivery of new twin-engine Aero Commander to be used by Fairchild for transportation of company executives in U.S. and Canada*

. . . . in the business hangar

Texas Gulf Sulphur Company of Houston brought one of its *Lodestars* to Lockheed Aircraft Service—International at New York International Airport (Idlewild) for strip and reseal of its integral tanks. LASI used the same sealant presently used for *Super Connies*, thus achieving an appreciable weight saving.

Jack Riley's *Twin-Navion* has been in the Horton and Horton shop for an exterior paint job. The leather interior matches the Ivory and Coral Flame exterior of the Dallas-based *Twin-Navion*.

The B-50 *Twin Bonanza* owned by the Salt Dome Production Company, Houston, Texas, has been equipped with a Flite-Tronics MB-3 Marker Beacon receiver and a CA-1 Audio amplifier. J. D. Reed Company, Inc., made the installation.

"Torchy" Lewis recently brought Thatcher Glass Company's *Lodestar* to L. B. Smith Aircraft Corp. for bat wing modification and general maintenance. "Torchy" is also his company's NBAA representative.

Col. Estelle, Manager of Esso Shipping Company's aviation department, and Harold Lamb, chief of maintenance, have taken delivery of their Convair 240 from Grand Central Aircraft at Glendale, Calif.

Oklahoma Pipe Line Constructors, Dallas, have another Remmert-Werner Super DC-3. This one replaces the company's first Super DC-3 which was destroyed in the disastrous hangar fire at Calgary, Alta, Canada. The new Super-3 is an exact duplicate, with Collins 17L-51R VHF multi-channel communications, dual Collins 51R3 Omni and ILS, dual Bendix ADF, Bendix Marker Beacon, and complete SAE panels. Gordon Koonce is at the controls.

George Holland, one of International Paper Company's pilots, brought his company's Twin Beech to Southwest Airmotive, Dallas, for 100 hour inspection, relicense, and engine removal and installation. Carl Lund and H. S. Galloway are International's NBAA representatives.

Norm Grele and Glenn Manke, pilot and copilot of Freuhoff Trailer's *Lodestar*, brought the plane to L. B. Smith for general maintenance. Home base for Freuhoff is Detroit, and Bob Kusse is the company's NBAA representative and chief pilot.

Ohio Oil Company's PV-1 (N5778N) has been in the Lear hangar at Grand Rapids for installation of a Lear L-5 autopilot with automatic approach coupler and altitude control. Ohio's pilot is Dick Yoakam.

Goodyear Aircraft's Convair is now equipped with a Narco DME. The installation was made by Airborne Communications of Cincinnati.

G. E. Warner and Jim Hall have Creole Petroleum's executive DC-3 back in Caracas, Venezuela after 1,000 hour overhaul, engine change and a new cabin interior installation by Executive Aircraft Service. The boys expect to be back in the States soon with Creole's other -3 for 1,000 hour overhaul, etc.

Bob Hansen and Art Vesely, pilots for Kroehler Manufacturing Company, brought the company plane to L. B. Smith for a new paint job.

Dresser Industries has hangared its Lockheed PV at Southwest Airmotive for 100 hour inspection, right engine overhaul and other general repairs. L. S. Montigny and W. R. Sanford flew the PV to Dallas. Montigny is Dresser's chief pilot and NBAA representative.

Skip Wittner brought Kewanee Oil's DC-3 to Remmert-Werner for a double engine change. After 871 hours of operation, Skip reported the Super-92's fuel consumption was one quart of oil per hour and 50.5 gallons of gasoline. Average horsepower used was 694. Skip is Kewanee's chief pilot.

Ted Hurlbut, chief pilot for Baker Oil Tools, Inc., has the company plane back in operation after an engine change at Grand Central Aircraft.

International Business Machines' DC-3 is back in operation after installation of an air-stair door, a combination Janitrol and hot air heat, Vapor automatic heat control, Goodyear brakes and a new exterior paint job. The work was done by Remmert-Werner.

Pilots Bill Watt and Dave Adams are back in the front office of the Hoover Company's DC-3. The ship has been in the L. B. Smith hangar for extensive radio work, a new buffet installation and other general maintenance work. Marshall V. McDowell is Hoover's NBAA representative.

Official NBAA Report

NATIONAL BUSINESS AIRCRAFT ASSOCIATION, INC.

(formerly Corporation Aircraft Owners Association)

National Business Aircraft Association, Inc. is a non-profit organization designed to promote the aviation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable business aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. NBAA National Headquarters are located at 1701 K Street, N. W. Suite 204, Washington 6, D.C. Phone: National 8-0804.

Airport Consultant Retained by NBAA

Recognizing the great importance of developing and improving airports for business flying in industrial areas around the nation, NBAA has temporarily retained the services of Cy Thompson, Airport Consultant. He will study the Federal Airport Program and provide the Association with facts and figures useful in formulating an aggressive policy for long-range planning of airports in communities of interest to business aircraft operators. Thompson recently served as Special Airport Consultant to the CAA Administrator.

NBAA Queries Answered by CAA Administrator

In response to a letter sent to the CAA Administrator in December, containing excerpts from correspondence received from our members, we are pleased to quote the main text of the Administrator's reply.

"I am very pleased with the pilot education program proposed in connection with the growing congestion on certain aeronautical communications channels. This type of program is commendable and should do much toward improving the situation on 126.7 mc as well as other air/ground communications channels. The stated requirement for a means of handling personal calls, aircraft servicing information, food requests, and other such communications between business aircraft and ground facilities, is also of interest to us. However, under the terms of Part 9, Regulations of the Federal Communications Commission, the only ground facilities which are authorized to handle personal messages from aircraft in flight are those designated "Aeronautical Public Service Stations." Aeronautical advisory stations using the frequency 122.8 mc or possibly the facilities of Aeronautical Radio, Inc., could perhaps provide the ground link for handling the other types of traffic mentioned. The frequency 123.0 mc would be inappropriate since it is planned to utilize this frequency at some future date for air traffic control communication purposes.

"With regard to the excerpt concerning our control tower criteria, I am able to advise that a project to revise the workload formula for staffing of control towers is well under way. The 1-5-10 point system is being discarded in favor of a more accurate means of determining workload and staffing requirements."

"On the subject of take-off minimums, corporate aircraft have no established regulatory minimums. Attempts have been made to establish take-off minimums for other than scheduled and non-scheduled air carrier aircraft, but thus far these efforts have not been successful. All pilots, of course, are required to take appropriate preflight action (CAR-60.11) and determine that the proposed flight can be safely conducted.

"The comment on the phraseology used by air traffic controllers to clear aircraft to descend in VFR conditions is appreciated as it brings to light not only discrepancies in the use of the phrase as outlined in the ANC Manual, 'Procedures for the Control of Air Traffic,' but also points up the need for an explanatory letter on the subject of alternate procedures to our field personnel. Actually, the alternate procedure to be followed by a pilot when he is unable to maintain VFR is left to the discretion of the controller since our manual does not attempt definition of this subject. However, there appears to be a logical use for the two types of alternate procedures to which you refer. Where descent in VFR conditions from 9,000 to 3,000 is involved, I agree that an alternate procedure, 'if not possible, remain in VFR conditions and advise,' is preferable. However, if only a descent in VFR conditions from 9,000 to 7,000 is involved, then it would appear that an alternate procedure specifying 'if not possible, maintain 9,000 and advise', would have some logical application, since normally a pilot can determine at his cruising altitude whether or not a 2,000-ft descent can be made VFR. I would not normally consider this procedure applicable for descents of greater magnitude.

"The congestion on some radio communications channels during borderline and IFR weather conditions is recognized. I do not think, however, that the answer is a race for higher powered airborne radio equipment. It appears that the channels which are over-congested are the so-called common channels which are not protected frequency-wise as are the discrete ATC channels. Also, these common channels at the present time have a mixture of compulsory ATC type messages and flight assistance type weather informational messages. We recognize the need for channel assignments based on the type of communication intended. We believe that this will not only relieve the congestion, but will automatically direct the message to the proper airways operations specialist on the ground for more prompt and efficient service."

"Since there are discrete ATC radio channel assignments made in all congested areas, additional airborne channel implementation is a far better answer than increase of power on a common channel.

"I sincerely appreciate your itemization of the various matters which are of direct interest to the members of your organization. It is through these means that we in the Civil Aeronautics Administration are able to take steps to improve our service to the flying public. It also provides us an opportunity to validate our position on various items which are of mutual interest and are not fully comprehended by some aeronautical services or air agencies."

Proposed Elimination of Annual Inspection of General Aircraft

The CAB Bureau of Safety Regulation has under consideration certain amendments to Parts 1, 18, 24, 43, and 52 of the Civil Air Regulations. The reasons are set forth below.

Currently effective Civil Air Regulations require owners and operators of general aircraft to have their aircaft inspected once a year by a representative of the CAA Administrator or an appropriately rated certificated repair station. It should be noted that the term "general aircraft" means all aircraft other than aircraft used by scheduled air carriers, irregular air carriers, and commercial operators. Prior to the annual inspection, such aircraft must receive a periodic inspection conducted by a certificated mechanic or a repair station. In addition, if the aircraft is used for hire, it must receive a periodic inspection each 100 hours of operation.

In recent years, the designated aircraft maintenance inspector (DAMI), and the repair station have gradually assumed the CAA agent's duty of conducting the annual inspection. This has resulted in the present procedure whereby the DAMI's and the repair stations actually conduct a combined periodic and annual inspection. The effect of this procedure has been to nullify the original concept of the double inspection, which to a great extent no longer exists. Under such circumstances a reasonable level of safety has been maintained, which indicates that a single system of inspection by an experienced mechanic or repair station is capable of assuring the continued airworthiness of aircraft provided the inspection system is based on time in service rather than on the calendar.

In order that the aviation industry and the flying public may benefit from these advances, it is proposed to eliminate the annual inspection of general aircraft. Such

MEET THE NBAA MEMBERS

RAY-O-VAC *aircraft are a Cessna 170 and Aero Commander (above) used in flights to Chicago and company plants. Bill Allen is Ray-O-Vac's pilot. Home base is Madison, Wis.*

Name of Organization: **Ray-O-Vac Co.**

Address: 212 E. Washington Avenue, Madison, Wis.

President: D. W. Tyrrell

NBAA Representative: O. B. Wynn
Chief Pilot: William H. "Bill" Allen

Nature of Business: Manufacture and sale of dry cell batteries for flashlights, radios, etc.; also manufacture and sale of flashlights and electric lanterns. Ray-O-Vac's original plant began operations in Madison, Wis., in 1906. The company acquired the Clinton, Mass., flashlight plant in the early 1930's and subsequently plants were started at Lancaster, Ohio; Sioux City, Iowa; Williamsport, Pa.; Jackson, Tenn.; Wonewoc and Fond Du Lac, Wis. The International Division has plants at Winnipeg, Canada, and Mexico City, and is acquiring one in Japan. The company's principal product is LEAKPROOF brand flashlight batteries, but it also makes farm fence, ignition and lantern batteries.

Aircraft Operated: Cessna 170 and *Aero Commander*

Most Flights Made to: Company plants and to and from Chicago to connect with commercial airlines and trains. Some trips are made to New York, Philadelphia, St. Louis and Kansas City.

Average Number of Hours Flown per Month: 55 hours

a change will relieve the CAA and the public of considerable administrative burden and will permit greater utilization of aircraft by the use of more economic and effective methods of inspection.

In place of the annual inspection, a periodic inspection will be conducted each 100 hours of operation or once a year, whichever comes first, by a mechanic holding a special authorization or an appropriately rated certificated repair station. As an alternative, it is proposed to authorize a progressive inspection system by an appropriately rated certificated repair station.

CAB believes either of these proposed procedures will be simpler and more economical to the owner since he will be relieved from securing the presently required annual inspection. If adopted, this will provide the owner or operator with two optional methods of inspection and permit the use of the most suitable for his needs.

The periodic inspection will be essentially the same as that required at present, while the alternate method will require inspections to be conducted at intervals and in such detail as to assure continued airworthiness. The detailed inspection of individual components and systems may be scheduled in progressive stages and the total time required for a given inspection will be materially reduced, thus reducing the time an aircraft is out of service.

In order to assure no reduction in the present level of safety, it will be necessary to permit only authorized mechanics and appropriately certificated repair stations to conduct periodic inspections, while progressive inspections will be limited to appropriately rated certificated repair stations. This is the controversial point of the proposed CAR.

NBAA's Board of Directors, after careful review and consideration of Civil Air Regulations Draft Release No. 54-27, titled "*Elimination of Annual Inspection of General Aircraft,*" unanimously agrees that the following areas of involvement for business aircraft operators should receive close study in the proposed changes: (a) increasing aircraft maintenance costs, (b) curtailment of flight operations, (c) dependence upon repair stations for all progressive maintenance, (d) conformity with maintenance procedures which may complicate both maintenance and operation scheduling, (e) difficulty of operator in adopting maintenance procedure to meet own operating requirements, (f) possible effect on business aircraft safety record and, (g) increasing CAA Administrative load by additional inspections.

It is NBAA's contention that business aircraft operators should be placed in a separate category from "general aircraft" and regulations drafted to meet specific requirements in this segment of civil aviation.

NBAA has forwarded a letter to the CAB Bureau of Safety Regulation stressing that proposed changes in the CAR not be adopted until a public hearing is held. NBAA believes, in the public interest and safety, the proposed rules should be fully aired before further action is taken.

The Bureau requests that all interested NBAA members who will be affected by the requirements of this proposal be fully informed as to its effect upon them and is, therefore, circulating copies in order to afford members ample opportunities to submit to the Bureau such comments as they may desire. Comments must be submitted in duplicate (copy to NBAA). Send to: Civil Aeronautical Board, Bureau of Safety Investigation, Washington 25, D. C. NBAA members who have not received a copy of CAR Draft Release No. 54-27, may obtain one by writing NBAA Headquarters.

New NBAA Members

The Cross Company
Detroit, Mich.
NBAA Rep: R. G. Brubaker, Chief Pilot
Company operates: *Aero Commander*

American Airlines, Inc.
New York, N.Y.
NBAA Rep: George C. Van Nostrand, Vice President

Lockwood, Kessler & Bartlett, Inc.
Great Neck, N.Y.
NBAA Rep: H. T. Harrison, Chief Pilot
Company operates: 2 Cessna 195's, a Consolidated-Vultee L-13

Disabled American Veterans
Cincinnati, Ohio
NBAA Rep: Mel Corbly, pilot
Company operates: *Aero Commander*

Earl F. Slick
Winston-Salem, N.C.
NBAA Rep: John N. Davis, Jr., Director of Aviation
Company operates: DC-3, *Aero Commander*

Perfect Circle Corp.
Hagerstown, Ind.
NBAA Rep: J. E. Leonard, Chief Pilot
Company operates: Grumman *Mallard*

A. M. Scaife
Pittsburgh, Pa.
NBAA Rep: Carl W. Christensen, Chief Pilot
Company operates: DC-3, *Aero Commander*

Flite-Tronics, Inc.
Burbank, Calif.
NBAA Rep: Wm. V. Viscarra, President

Aircraft Radio & Accessory Co.
Denver, Colo.
NBAA Rep: Chas. O. Peacock, Vice President

New beauty...New safety...New cabin quietness!

Outstanding among the many new features of the 1955 Cessna 180 is a new "hushed" cabin . . . engineered to give you almost unbelievable quietness in flight.

Over-150-mph speed—outstanding luxury, stability, ease of handling—you get all that in the Cessna 180 . . . and now a great new advantage has been added! Cabin quietness so complete you have to experience it to believe it—made possible by an improved engine that delivers the same horsepower at fewer RPM's—relocated ventilator intakes—and a new ¼-inch thick windshield. Yet you get all this at the same low price of $12,950 f.o.b. Wichita. Ask your Cessna dealer to demonstrate or write CESSNA AIRCRAFT CO., Dept. S-3, Wichita, Kansas.

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Long, wide "Para-Lift" flaps give your Cessna 180 easy access to the smallest landing areas, lowers the airplane at the speed of a descending parachute or sweeps you off of short runways in seconds! Easily operated through 3 positive positions by a seat-side control. A safety "must" for high-altitude, short-field flying!

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No complicated parts! Nothing to service. Always down and locked! And now the spring steel landing gear on the Cessna 180 has been moved 3 inches forward to make landings safer and easier than ever!

Room with a View!

Inside the "hushed" cabin you get your choice of fabric color combinations—soft, adjustable foam rubber seats—all-weather heating-ventilating system 96 vents and defroster. Luxury of the finest automobiles but *3 times the speed!* Behind the rear seat —120 lbs. of luggage—and you can reach it in flight!

CESSNA 170 180 195 310 THE COMPLETE AIR FLEET FOR EVERY BUSINESS NEED!

VORTAC Decision Tosses Hook at All DME Makers

The unprecedented abruptness and finality of the announcement of the VORTAC Committee (to investigate the comparative merits of the military-sponsored, and at time of writing still hush-hush, TACAN navigational system *vs* VOR/DME) has thrown a bombshell into the industry. To have so unequivocally stated that because of its unrevealed superiority and the admitted advantages to the military, TACAN *must be* the system of the *immediate* future, is to boldly toss the gauntlet into the faces of the manufacturers who have matched government funds with millions of private risk capital. Likewise, a large proportion of the long-suffering flying public, some airlines and many large corporation aircraft have responded to last year's official assurances that DME would not be sacrificed to TACAN, at least not until investors had had a reasonable opportunity to amortize their DME and associated equipments.

Whatever Washington knows, the rest of the country (in and out of officialdom) does not know at this writing of the tremendous superiority of TACAN upon which this momentous decision was based. If, therefore, TACAN is going to be such a vital necessity that all the flying public must use it so that the military can have it (and no one questions their need is of paramount importance), why then has TACAN been surrounded so long with such secrecy?

If security is going to be breached with the first installation (if not before) of a public ground facility and the first sale or operational description of a civil airborne unit, where is the justification for all the hokus-pocus during the evaluation considerations? If the Russians immediately copy and install it, should not the military be jubilant, or do they want to forestall a Russian claim to its discovery? To be less facetious, can we create any system of aerial navigation (and demand its use by the civil aviation public) that an invading bomber fleet could not make use of unless it were denied to both civil and military?

Considerable energy has been expended by industry and government experts in developing associated procedures for the maximum utilization of DME as both an enroute and approach aid. These agencies are now thrown for a loss by the abrupt public notice that they have been chasing a will-o-the-wisp. It is hoped that by the time you read this, the whole matter will have been aired publicly.

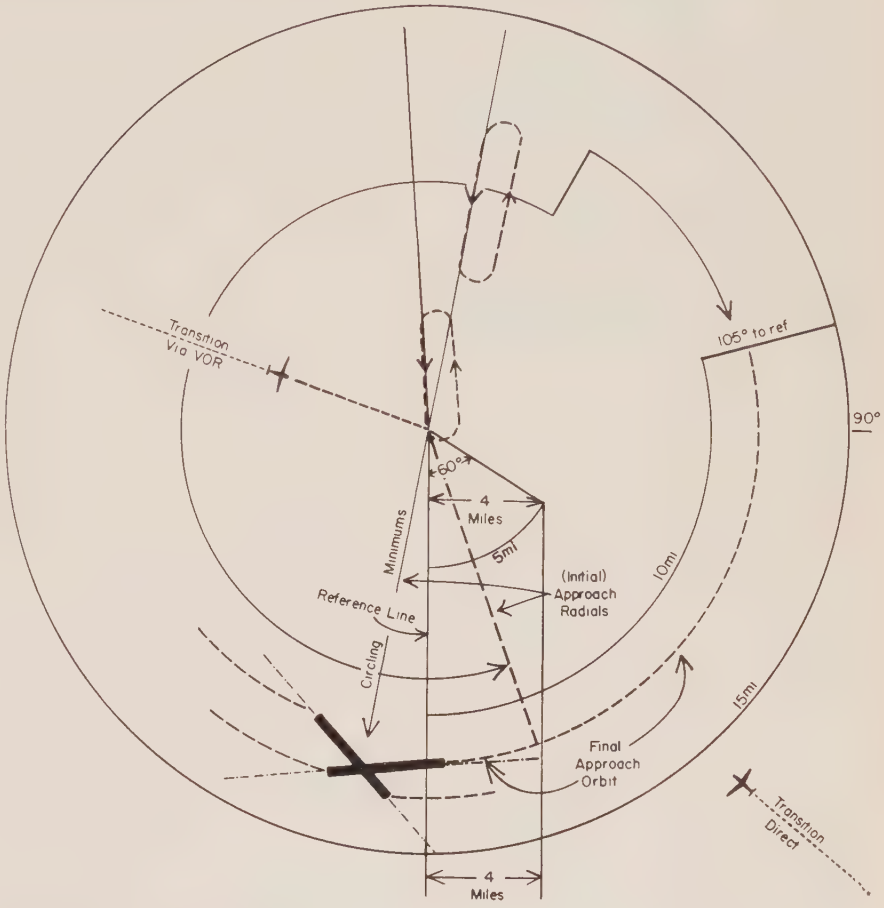

DIAGRAM *illustrates typical orbiting approach. VOR is about 21 miles from airport*

However, as of now, it may be advisable to briefly review these procedures on which so much time and energy have been hopefully expended with DME. Remember as you read that all development of equipment and procedures may cease within the year; also that some dissatisfaction with anything but enroute use of DME has been lurking sub-surface in both official and private circles and may reflect a possibility that the military is not alone in wishing to drop DME. On the other side of the fence, remember that the so-called superior accuracy of TACAN is only theoretical and that the TACAN system and reliable and usable equipment does not exist today. DME does.

Regarding VOR, it is forecast that its useful life may be another 10 years, which, added to the past five or more years, seems a reasonable amortization period, considering the rate of technical progress. In that period of time, the accepted 3° DME error (TACAN promises no more than 1° but that is as yet unproved), plus the NOTAM'd unreliability of a startling high percentage of courses of an equally high percentage of VOR's may make the flying public ready for a new system that will then have had 10 years of public-service testing.

DME, combined with VOR bearing information, is virtually a continuous and instantaneous source of position, but this position fix is only as good as the combined accuracy of four factors, the VOR and DME ground transmitters and the airborne VOR and DME receivers. VOR, the most accurate system of bearing information in common use today, accepts combined errors of up to 6°. Add to this the current DME standard of 3% to 5% error in distances of 100 to 200 miles, and a greater percentage involved in

possible errors of one-half to one mile at distances common to instrument approach procedures. The net result is that we know to a finer degree *approximately* how far we are in a *somewhat less general* direction from or to a specific place. Of course, this is a thankless belaboring of the very significant advance that VOR and DME represent over previous standards of navigation and position fixing. The point is, however, that it is not as yet accurate enough to warrant commissioning of DME enroute and approach procedures not already existent without DME. Nor have means of guaranteeing a minimum standard of performance been established.

For enroute purposes, DME airway procedures based on the accepted standards of accuracy, reasonably approximate pictorial-type presentations of position information.

ATC-wise, DME fixes could accomplish the following:

- More frequent variations in minimum altitudes along any sector of airway where previously unnecessarily higher altitudes have had to be maintained between widely spaced fixes.
- Easing of the necessity for cross-bearing fixes on navaid facilities other than enroute ones, for position information and ATC expediting.
- More practical location of reporting points from the standpoint of ATC purposes.
- Narrow the spread between minimum enroute altitudes and minimum reception altitudes as a result of elimination of VOR cross-bearing fix requirements.
- More accurate holding patterns resulting in more efficient use of available airspace in crowded or conflicting airspaces and airways.

Current evaluation of the error factor mentioned earlier indicates that a correction factor of 10% or 1½ miles, whichever is greater, should suffice for operational enroute purposes. Thus, terrain clearance requirements can be met by permitting descent after overpassing an obstruction of known position along an airway, by this percentage of the known distance of the obstruction from the DME facility used.

Responsible persons concerned with this problem are reluctant to go further than this in publishing procedures for use employing DME as a significant component. Careful surveillance of DME receivers employed by cooperating non-government agencies during evaluation periods suggest that certain factors within airborne components and from outside sources can result in errors of a serious magnitude when considered in the light of the requirements of a low instrument approach.

Air-Aids Spotlight

ATLANTA, Ga.—*VAR on 109.1 mc and CAMPBELLTON LFR on 314 KC to be decommissioned. Disposition of ADAMS holding unannounced.*

BOSTON, Mass.—*Avoid flight below 3,000 ft in the area west of the Custom Housing Tower between the NW and SW legs of the Boston LFR. Outer limits of the area a line between the Arlington Gas Holder and Franklin Park.*

CHARLOTTE, N.C.—*VOR to be commissioned on 117.2 mc, located just west of Ft. Mill 13 n miles S of field, bearing 006°-186°.*

CINCINNATI, O.—*Airport Surveillance Radar, not yet commissioned at time of Covington accident, now operational on 124.7 mc.*

CLEVELAND, O.—*VOR freq change in March to 113.6 scheduled.*

COLUMBIA, S.C.—*VOR/DME shut down for relocation on new site 5.5 mi SE of airport.*

DOTHAN, Ala.—*LFRange freq due to change to 368 KC.*

HUTCHINSON, Kan.—*LF-Range freq now 356 KC. Old freq 227 KC now at VIOLA radio beacon on SW course Wichita LFR.*

ISLIP, N.Y.—*Local control freq now 119.3 mc.*

RALEIGH-DURHAM, N.C.—*ILS Outer Compass Locator now 219 KC; Middle Locator 201 KC.*

SIOUX FALLS, S.D.—*ILS Outer COMLO now 254 KC.*

TOLEDO, O.—*"TOL" identifier now applies to TOLEDO EXPRESS AIRPORT. Old Municipal Airport now "TDX." LVOR on 113.6 mc decommissioned. This also corrects Localizer identifier, Outer and Middle Locator originally NOTAM'd as "TLX" quoted in Feb. issue.*

That these errors are not always easily caught by the pilot is further cause for hesitation. It may be necessary for the pilot to be able to check the accuracy of his equipment immediately prior to such use on a low approach. If the procedures based on DME are to be restricted because of the lack of such error-detecting and evaluating methods, plus lack of performance standards regardless of price and weight factors, we will have gained little from the development of DME beyond enroute usage.

The desirability of incorporating DME into existent procedures is undeniable. Its employment with ILS for range information and glide slope checking is incomparably more economical and practical than installing Precision Approach Radar everywhere and hiring a highly trained and paid approach controller to give range information. The same reasoning is involved in straight-in VOR approaches. Basically, TVOR's or Terminal VOR's situated on the airport relieve DME of all but the range chore.

Similarly, a system of instrument approaches to an airport where straight-in approaches over the VOR facility are not practical by reason of layout, terrain or wind, is in great need, but accuracy must be unquestioned if minimums equal to or lower than many circling minimums are to be hoped for. Again, Airport Surveillance Approach radar can do this job, but at a tremendously greater price.

Although this goal is somewhat more remote of accomplishment, it is desirable to examine the probable procedure which may be employed. The distance between an airport and its associated VOR/DME facility must be such to insure that the 3 to 5% error or ½ to 1 mile, whichever is greater, is neither so great nor such a large proportion of the total distance involved that it becomes unacceptable. Secondly, a circling approach VFR or even "ground contact" is one thing, and a circling (orbiting) approach fully on the gauges is quite another. Hence, the distance of the "final approach orbit" from the facility must be of sufficient radius to not compel an angle of turn or bank in excess of 30°. Nor should the radius, and hence circumference of the final approach path, be so short and precipitous than an overshoot is encouraged.

An illustration of a typical orbiting approach and its determination is

offered in the accompanying diagram. Shown is an example where a VOR is located approximately 12 miles from the airport to be served and at approximately 90° from the centerline of the runway to be used. Note that the selection of the instrument approach runway in this instance is influenced by the fact that the final approach orbit or path provides essentially a straight-in final for the critical last four miles. Thus, employing the existing standard that any angle of approach to a runway must not exceed 30° to justify straight-in as against circling minimums, we can determine that the reciprocal of this runway might just meet these requirements, whereas both ends of the intersecting runway very probably would not, one requiring a last-minute turn in excess of 45° to align with the runway, the other a sharp roll-over from a left turn to a right turn, etc.

For the purpose of obstruction clearance, the final approach area extends two miles symmetrically about the final approach orbit or path. Minimum obstruction clearance is planned as 300 feet for that portion of the final approach area lying between the (initial) approach radial and runway.

Examination of the diagram will show that transitions made via radials of the facility that intersect the final approach orbit at a point between the point of turn on final and a point 105° counter-clockwise from the approach radial, do not require overheading the facility, given a final approach orbit located from 10 to 15 miles out from the facility. All other transitions via radials that would fall outside of this pie-shaped circumference would be made via the VOR facility.

Procedure turn and let-down (shuttle, if any) would be common to all procedures for the airport, and the radial employed for this purpose would not necessarily be the reciprocal of the approach radial to the final approach orbit and, therefore, two or more approach radials could be established.

All radials would be quoted as magnetic headings, and nautical miles quoted and employed except for visibility minimum figures. It could well be that many changes and/or other methods of employing the DME for instrument approaches may be devised, but certain it is that either a higher standard of uniform accuracy, comparable to ILS/GCA may have to be achieved, plus a means of assuring such accuracy at the time of starting an approach, before orbiting approach minimums could meet or surpass the present circling minimums.

Therefore, the prospective use of DME as an approach aid on other than an established ILS system may not be a significant factor in any easement of the decision to discard DME. Inasmuch as the government may be able to ease the loss to the manufacturers with comparable TACAN contracts, could not the granting of such contracts be contingent upon some easement of the loss to the flying public already DME-equipped?

Skyways has never joined the ranks of the view-with-alarmist nor with professional group agitators who fight every effort of technical advancement in the over-all interests of the country. If TACAN is so much better than VOR/DME that it is vital to the military as a navigational system, then it is even more vital to the civil flying public that somehow looks upon itself as even less expendable than military aviation in peacetime. But if so, why the secrecy up to now and why cannot it be done in a manner that acknowledges the obligation to all who have acted upon the assurances given in the past?

Fortunately, perhaps, the position taken by ANDB is not the final disposition of this TACAN *vs.* DME controversy. Congressional howls reflecting the attitude of the taxpayers whose dollars will have been tossed down the drain by this decision, and the howls of other civil groups may rescue the government's, private industry's and the using public's already tremendous investment in VOR/DME, the accuracy of which (according to CAA assurances) could be of the same order as that *anticipated* with TACAN.

New York & Philadelphia Preferential Routing List

In the last year since we last published the preferential routing for the New York and Philadelphia areas, experience has shown that not only are some changes desirable but also that filing of these routings by pilots leads to less delay in obtaining clearance and eases flight plan calculations. A year ago, many of the most heavily traveled routes were available only via LF facilities and routes. This is no longer so and in the following tabulation, the most significant changes are in italics. Note also that reference is made to the new "one airway number" identification along the most-used routes between high-density terminal areas. (See "*Airway Routes Redesignation*")

In the "*Information Bulletin*" (available from the Office of the Chief Controller, New York ARTC Center, La-Guardia Field, N.Y.) issued by CAA, it is noted that deviations from preferential routings will be approved for such bonafide reasons as adverse

You can use virtually every modern VHF navigation aid available today with the compact Narco Omnigator installed in your airplane—Omni, ILS, VAR, 75 mc marker beacon plus high-powered transmission and VHF reception.

± 2° ACCURACY

New improved design features now permit the highest degree of VOR bearing accuracy far exceeding IFR standards. Every Omnigator is individually checked and factory-certified to have better than 2° accuracy (3° required for IFR). Large-scale dial permits precise course selection.

PLUS these features:

- **ILS Localizer** for accurate runway approach guidance.
- **75 mc Marker Beacon** for positive position checks.
- **VAR Navigation** on visual aural range.
- **8-CHANNEL, 3-WATT TRANSMITTER** for powerful long-range transmission.
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- **INSTALLATION EASE.** The Omnigator is compact for glove compartment mounting. Thousands of Omnigators in use in multi- and single-engine business aircraft. Priced far lower than any comparable equipment. See your NARCO dealer today.

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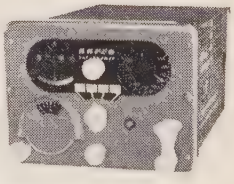
Dependable, low-cost Omni, with 4-channel VHF transmitter and tunable receiver. By far, the most popular OMNI in use today.



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narco

NATIONAL AERONAUTICAL CORPORATION
Ambler, Pennsylvania

weather conditions (icing, turbulence, thunderstorms, strong headwind components, etc.), inoperative radio navigation aids, atmospheric or precipitation disruption of communications, or unreliable radio reception.

Preferential routes are not intended to deny use of high-altitude direct off--airways routes. However, they will be used when such aircraft are in climb-to, or descent-from altitudes authorized for direct off-airway flights.

INBOUND IFR FLIGHTS ** NEW YORK ARTC AREA

(Note: For Teterboro see Newark (EWR); for Zahn's see Idlewild (IDL). For other three-letter identifiers see your RF and Jeppesen charts.)

From	To	VOR Route	LF Route
NORTH			
via ALBANY, N.Y.	EWR	V91, V39, B18 Paterson direct EWR LOM	B18 Paterson direct EWR LOM
	IDL	V91	B18 Peekskill direct HPN LOM, direct Glen Cove B18
	LGA	V91 Wilton direct RWC R3	B18 Peekskill direct HPN LOM, direct RWC R3
NORTHEAST			
via BOSTON	IDL	*V16 RVH, V46 XSJ, G5 HEM direct IDL*	G5 HEM direct IDL
via HARTFORD	EWR	*V3 PNJ direct EWR LOM*	*A7*
	IDL	V167	R21, R23, B18
	LGA	V3, A7, R3	A7, R3
SOUTH			
via NORFOLK	EWR	V1 OLT direct EWR LOM	R77, B49, B20, A7
	IDL	V1 Coyle G5 Ambrose direct Scotland	R77, B49, G5 Ambrose direct Scotland
	LGA	V1 Colts Neck G3	R77, B49, B20, *A19*
SOUTHWEST			
via WASHINGTON	EWR	*R45, V140, A7, V140, A7*	*Hartly R72, A7*
	IDL	*R45, V140, A7, V140, B18*	Hartly G5 Ambrose Scotland
	LGA	*R45, V140, A7, V140 OLT*	Hartly R72, *A19*
WEST			
OFF PITTSBURGH	EWR	V58, V10, A7	R13, G3, A7
	IDL	*V58, V10, B18*	R13, G3 Regan Red Bank
	LGA	*V58 PSE V10 OLT G3*	R13, G3
OVER PITTSBURGH	EWR	V12, V162, V39, V10, A7	R13 G3 A7
	IDL	V12, V162, V39, V10, B18	R13, G3 Regan Red Bank
	LGA	*V12, V162, V39, V10 OLT*	R13, G3
via CLEVELAND	EWR	V6, V10, A7	G3, A7
	IDL	V6, V10, B18	G3 Regan Red Bank
	LGA	V6, V10, OLT G3	G3
NORTHWEST			
via DETROIT	EWR	*V116, V170, V10, A7*	*R19*, G3, A7
	IDL	*V116, V170, V10, V16, B18*	*R19*, G3 Regan Red Bank
	LGA	*V116, V170, V10 OLT*	R19, G3
via BUFFALO	EWR	*V36, V147, V10, A7*	R23, R26, A7

RTCA System for Pilot Control of Airport Lights

The Radio Technical Commission for Aeronautics has recommended a system for the activation of airport field lights by radio transmissions from aircraft.

A report being distributed to RTCA members describes the results of a study conducted by Special Committee 56 to determine the best practical system for operating the lights of airports which are unattended at night. The report recommends system-performance characteristics and operational procedures and lists the required airborne and airport equipment.

Numerous systems for the operation of airport field lights from aircraft have been devised and evaluated on an experimental basis during the last 20 years. These systems were of two general types:

1) Audio systems, in which a microphone on the ground picked up the sound of an aircraft engine and propeller and actuated the lights.

2) Radio systems, in which a ground receiver picked up transmissions (usually on 3105 KC) from aircraft and actuated the lights.

Both systems functioned satisfactorily under favorable operating conditions but had serious limitations under adverse conditions.

For example, the audio systems require a sensitivity low enough to prevent triggering by ground noises, by the sound of thunder and rain, or by large aircraft passing overhead at cruising altitudes. Yet this low sensitivity makes it necessary for a small aircraft to pass directly over the microphone at low altitude and with full power to activate the system.

In the radio systems, the propogation characteristics of the frequencies used were such that instances occurred where aircraft hundreds of miles away inadvertently operated airport field lights. In addition, electrostatic interference produced by lightning and other atmospheric disturbances occasionally caused continuous operation of the lights.

In an effort to solve these problems, Bonanza Airlines last year tested a lighting system activated by signals from an aircraft communications transmitter operating in the VHF band. Use of VHF frequencies with their "line of sight" limitations at the low approach altitudes minimized the disadvantages previously encountered in HF transmissions, such as 3105 KC.

The success of the Bonanza experiments prompted a request to RTCA from the Air Transport Association for an over-all study of the control of ground lights from aircraft to permit

From	To	VOR Route	LF Route
	IDL	*V36, V147, V10, V16, B18*	R23, R26, G3 Regan RDB
	LGA	*V36, V147, V10 OLT*	R23, R26, G3
ROCHESTER	Same as BUFFALO, except delete V36 and R23		
SYRACUSE	EWR	*V29, V34, B18, PNJ direct EWR LOM*	*R26, G3, A7*
	IDL	V29, V34, V91	R26, G3 Regan RDE
	LGA	*V29, V34, B18 Peekskill, White Plains LOM direct New Rochelle*	*R26*, G3
IDLEWILD LGA or EWR	PHL	Bellemead V3, B20	Bellemead R72, B20
via WILKES BARRE	PHL	Colts Neck V140	Ambrose G5, R73, B20
	PHL	R13, V29, B20	*R26, G3, B20*
via DETROIT	PHL	*V116, V170, V140*	*R19, G3*, R3, G4
via CLEVELAND	PHL	V6, *V170, V140*	G3, R3, G4
via PITTSBURGH	PHL	V12, V140	G4
via WASHINGTON	PHL	*BAL V140, A7, V140*	*A13* (Max alt-4,000 ft)
via NORFOLK	PHL	*V1, V29, V140*	B56, R77, B20
NORTH			
via ALBANY	IDL	*Syosset V91*	GNC HPN LOM Peekskill B18
	LGA	POU LFR V39, V91	POU B18
	EWR	POU LFR V39, V91	POU B18
NORTHEAST			
via HARTFORD	IDL	*Syosset V167*	Bay R21
	LGA	*Syosset V167*	Bay R21
	EWR	POU LFR V39, V58	POU R13
via BOSTON	IDL	*RIVERHEAD V16*	St. James G5, G2
	LGA	*Syosset V167, V34, V16*	St. James G5, G2
SOUTH			
via ATLANTIC CITY	IDL	*Colts Neck V1*	Ambrose G5 Coyle direct AIY *(only if landing AIY)*
	LGA	Colts Neck V1 *(subject LGA inb'ds)*	St. James G5 Coyle direct AIY *(only if landing AIY)*
	EWR	Colts Neck V1	*Bellemead R72, B20, R77*
via PATUXENT, Md.	IDL		Ambrose G5, B49, R77
via NORFOLK	PHL	*MILLVILLE B49, V1*	Millville direct Dover R77, B56
SOUTHWEST			
BALTIMORE	IDL	*Colts Neck V16, V44*	Ambrose G5, B20
	LGA	*Bellemead V3, V93*	Bellemead *A14*, R17
	EWR	*Bellemead V3, V93*	Bellemead *A14*, R17
via WASHINGTON	IDL	Colts Neck V16 *(Specify Andrews direct DCA when landing DCA)*	Ambrose G5 (same note)
	LGA	*Bellemead V3, V93, BAL 225° radial, DCA TVOR*	Bellemead *A14*
	EWR	*Bellemead V3, V93, BAL 225° radial, DCA TVOR*	Bellemead *A14*
	PHL	*Westchester (ESR) V3, V93 BAL 225° radial* DCA TVOR	Calvert A7 (Max alt—*4,000 ft)*

RTCA System for Pilot Control of Airport Lights

(Continued from opposite page)

night landings at unattended airports.

The RTCA report recommends a radio system using the frequencies 121.7 mc and 121.9 mc by all aircraft and 122.8 mc by private aircraft. This use would be in addition to the present use of 121.7 mc and 121.9 mc for ground-to-ground airport utility communication and the present use of 122.8 mc for a two-way communication available only to private aircraft.

A system of codes is provided so that in areas where two or more airports are located in close proximity, a pilot may activate the lights of only the airport at which he intends to land. A further reason for using coded signals is to prevent activation of airport field lights when the frequency is being used for communication. Five such codes were recommended, each consisting of a given number of dashes produced by pressing and releasing the microphone button of the aircraft VHF transmitter. Thus, any aircraft could transmit any of the five codes, but the decoder of any given airport system could accept only one code.

Once the lights are turned on, they would remain on for a pre-set period of, perhaps, 15 minutes. Before going off automatically at the conclusion of the "ON" period, an attention signal (such as alternate dimming or ON-and-OFF operation of the lights for a period of one or two minutes) would alert the pilot to the imminence of the lights going off. Once so alerted, the pilot could re-initiate the "ON" period by repeating the activating signal.

Attempts to include "fail-safe" features in the system resulted in high complexity and cost problems outweighing the advantages of the system. Hence, it was recommended that use of the system be restricted to conditions under which failure of the system would not jeopardize safety.

The Federal Communications Commission was asked to initiate the rule-making that may be required to authorize use of the three frequencies chosen for the system.

Radio Station Regulations

The Federal Communications Commission has advised of two Regulation Amendments No. 9-7 and No. 9-8, Part 9, pertaining to aircraft radio stations. These are of importance not only to individual aircraft and fleet owners but also to operators of maintenance, service and storage facilities whose customers will be affected. These amendments are as follows:

From	To	VOR Route	LF Route
WEST			
via PITTSBURGH & COLUMBUS	IDL	Caldwell, Stroudsburg R8 (Butler-PIT) V12	GNC, RWC, Chatham, R8 (Butler-PIT), G4
	LGA	Branchville V36, V58, R8 (Butler-PIT) V12	*Stroudsburg* R8 (Butler-PIT) *G4*
	EWR	Stroudsburg R8 (Butler-PIT), V12	Same as LGA
	PHL	Lancaster V12	Lancaster G4
CLEVELAND	IDL	Caldwell, Stroudsburg R8, V6	GNC, RWC, Chatham, R8, G3
	LGA	Br'ville V116, V14	Br'ville R23, *R11*, B11
	EWR	*Same as LGA*	Stroudsburg R8, G3
	PHL	Lancaster V12, *V42*	Lanc'tr G4, *R85*, R20
NORTHWEST			
via DETROIT & CHICAGO	IDL	*Caldwell, Str'burg, V164, V116 DET, V42*	*Glen Cove, RWC, PNJ, R23* R11, R12, G2 DET, R12
	LGA	Br'ville V116 DET V116 DET, *V42*	Br'ville, R23, R11, R12, G2 DET, R12
	EWR	Str'burg V153, V116	Br'ville R23, R11, R12, G2, R12
	PHL	Lanc'tr V12, V42	Lanc'tr G4, R85, R20, G2
via WILKES BARRE	PHL	Wings B20, *V149*	Wings B20, G3, R26
via BUFFALO	IDL	C'well, Str'burg, V153, V36	GNC, RWC, PNJ, R23
	LGA	Br'ville V36	Br'ville R23
via ELMIRA	EWR	Str'burg V153, V36	Str'burg R8, R26, R23
via BINGHAMTON	EWR	Str'burg V153, V29	*Br'ville R23, R26*
via ROCHESTER & SYRACUSE	IDL	*Syosset V91, V34, V29*	GNC, RWC, PNJ, R23, R26, R29
	LGA	Br'ville V36, V29 SYR, V29, V34 ROC	Br'ville R23, R29 ROC, R23, R26 SYR

Groups of adjacent altitudes have been allocated with some single altitudes along certain airway segments.

Airway	From	To	Altitudes	Flight Direction
V140/A7	DCA Bdry	PHL	6,000 thru 12,000	North (enr't over PHL)
V3/R72	CAT	NXX	4,000 " 6,000	South
A14	BMD	LRP	7,000 " 12,000	South
V3	BMD	DCA Bdry	7,000 " 12,000	South
V10/V6/G3	PSB	BMD	7,000 " 17,000	East
R8	CAT	SSB	3,000 and above	West
V116/V36/R23	PNJ	E.SCR	MEA and above	West
V3/A7	BOS Bdry	ILT/PCH	6,000 thru 9,000	South
G5	HEM	BOS Bdry	3,000 " 5,000	North

(Note: At press time, CAA issued NOTAM advising of some delay in effecting Washington Area portion of revised routings but same may be operational by date of this publication.)

Radio Station Regulations

(*Continued from page 29*)

Section 9.105(a) (1)

New or modified station license application shall be on Form 404.

Section 9.105(b)

Renewal shall be applied for on Form 405-A within the last 60 days prior to expiration. An application so filed will extend the existing license until action is taken on application.

Section 9.107

New license application is necessary upon sale or transfer of aircraft.

Section 9.116

License period will be for terms of one to five years, with renewals good for four years.

Section 9.118(b)

Normally, station licenses must remain posted and easily accessible in the aircraft, but single licenses applicable to air-carrier fleets may be photostated for this purpose. (No mention of extending this privilege to non-air-carrier fleets was made.)

New Hi-Freq Transceiver Offered for Int'l Use

One of the fastest growing fields of operations has been the cross-border traffic of non-air-carrier aircraft. Where once all such airborne commerce was carried by the scheduled airlines, today the aviation and general press is full of accounts of worldwide international operations of both corporation and private aircraft. Additionally, the market for export of postwar aircraft of advanced design has changed from purely a military and airline field to one of business and utility.

Paradoxically, the development and production of long-range high-frequency aircraft radio equipment has fallen off, except in the high-cost and high-weight equipment category of the large international airlines. As a result, owners of private or business aircraft contemplating flight operations out of the United States often have been compelled to seek outmoded and discarded high-frequency equipment or do without.

Despite ICAO, the sad facts of life are that the virtues VHF are little recognized outside the domestic U.S. and a few Western European nations. Although the use of certain agreed VHF communications channels are slowly taking hold for local short-range purposes, navigational beacons and communications between widely separated points on all other parts of the globe are based primarily on the use of high frequency.

Thus, it is a great boon to hear that Sunny South Aircraft Service, Inc. at Broward County Field, Fort Lauderdale, Fla., has been receiving accolades from the owners of SUNAIR 5- and 11-channel high-frequency transceivers. Frequency range is from 2,000 to 10,000 KC, crystal-controlled. Already installed in aircraft ranging from exported Piper *Tri-Pacers* to Aviaca Airlines' four-engined fleet, these radios are offered in both direct and remote-controlled installations, with prices ranging from $795 to $1,395. The reel-type antenna that is used is priced at $37.50, with additional crystals available at $10 each.

Space demands are small, and weight of the SUNAIR sets varies from 23 to 25 lbs. The radios operate

on either 12 or 24 volts. Use of high quality standard radio parts eases the service and maintenance problems usually associated with operations out of the domestic U.S.

Judging from reports from users of the SUNAIR transceivers, this lightweight equipment is comparable and in some cases even superior to expensive equipment long in use on international flag carriers. For example, users working the radio at 2,000 ft. enroute New Orleans to Brownsville, have been interrogated and have carried on complete contacts with stations in Cuba, Mexico City and Panama. Signal strength is such that station personnel often are surprised to learn that the contacting aircraft is not one of the largest airline types.

Max Conrad insisted on this equipment for his direct non-stop New York to Paris hop in the Piper *Apache* last fall. Only this equipment could have given him the 1,000 to 1,500-mile range he needed and still stay within the weight allowance he could tolerate. The ideal installation for most foreign usage undoubtedly would include a VHF communications radio for close-range, static-free operation, but the SUNAIR transceiver probably would get the most usage.

Air Routes Re-designated To Provide Simplification

In accordance with a policy referred to in an earlier issue of *NAVICOM*, the domestic airway route structure is being rapidly re-designated to provide much needed simplification of route identification. Most of the airway number designations have just grown "like Topsy," and in certain parts of the country, IFR flight and ATC clearances have passed the point of aggravating complexity and have reached the point where they could be a factor in hazardous traffic confliction.

It is suggested that pilots use care in referring to all airways charts for some time to come inasmuch as the changes will be many, and in numerous cases airways will have two numbers, one for the entire airway route between major terminals and another covering the airway segment between intermediate points.

AMBER 13—*Washington to New York (area). From RIVERDALE radio beacon via the intersection of a 70° mag bearing from RVD and the south leg of the Baltimore LFR; (SEVERNA PARK) to the BAL LFR; to the intersection N/BAL and W/PHL LFR; to the PHL LFR; SW and NE legs of the N. Phila. LFR; SW leg of the Newark LFR to the EWR Airport.*

AMBER 14—*New York to Washington (as read southbound). From the CHATHAM radio beacon to the intersection of the E leg Allentown LFR and the NE leg of Willow Grove LFR (BELLEMEAD); via the NE leg Willow Grove to the NXX LFR; direct to the LANCASTER (LRP) radio beacon; to the intersection of the S leg Harrisburg LFR and the NE leg Arcola LFR (WESTMINSTER); via the S leg of HAR-or-N leg of Andrews LFR to the intersection with the W leg of the BAL LFR (ELLICOTT CITY); direct to the RIVERDALE radio beacon; direct to the Washington National Airport. (Old route—R72 R45 R33 R29 Ellicott City direct RVD)*

AMBER 15—*Washington to New York. Same as Amber 13 as far as Philadelphia; then via the NE leg PHL LFR to its intersection with the SW leg of LaGuardia LFR (FREEHOLD), and with the SW leg of Idlewild LFR (RED BANK); to the IDL Airport. (Old route—R45 R29 A7 R3 B18)*

AMBER 19—*Washington to New York. Same as Amber 15 as far as FREEHOLD; thence via the SW leg LGA*

(*Continued on page* 32)

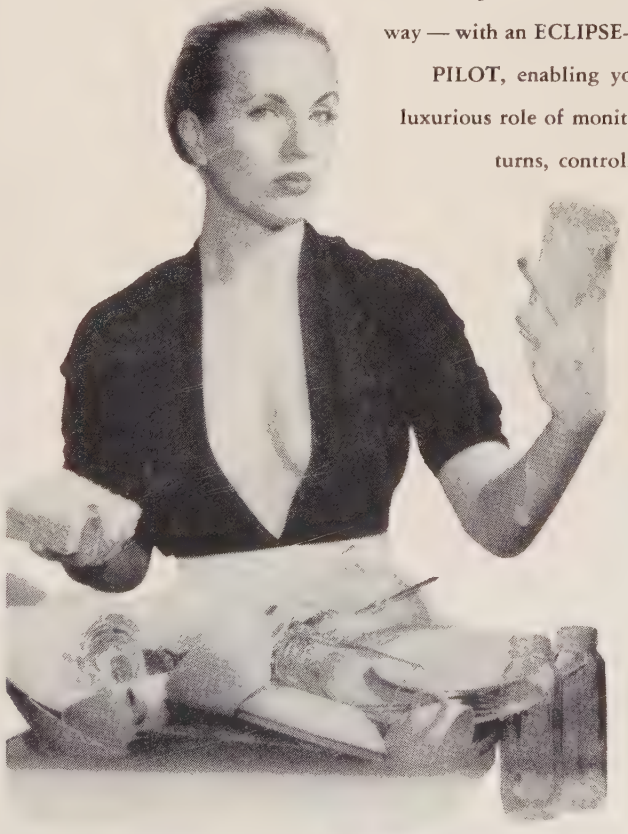
BUSY

MOODBEAMS
4

The only thing busier than a modern housewife without an automatic dishwasher is a modern aeronaut without an automatic pilot.

Dishes can be cleaned nowadays at the flip-of-a-switch, enabling Dee Brock (24, 126 lbs., 5'7", blonde, green-eyed) to settle down with a good book—or something.

An airplane can be flown pretty much the same way — with an ECLIPSE-PIONEER PB-10 AUTOPILOT, enabling you to settle down in the luxurious role of monitor-only, making precision turns, controlling your altitude, neatly trimming the aircraft and, finally, through its FLIGHT PATH COMPUTER, locking into ILS to bring you safely and surely home down the Glide Path.



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LFR to its intersection with the E leg Allentown (REGAN) and to the LGA Airport. (Old route–R45 R29 A7 R3 G3)

Many others have been over-designated, principally VOR routes. Other high-density routings between major terminals found most practical for expediting air traffic control will be designated shortly and will be coincident with preferred long-distance routes.

Low-Cost VHF Navigation System Undergoing Test

A new low-cost system of navigation for military, commercial and private aircraft presently is being service tested. Temporarily installed in conjunction with the Dover (Del) VOR, the Aural Bearing Generator, as the new aid is called, will supplement the internationally adopted VHF Omni-Range System (VOR). Developed by Vernon I. Wiehe, world-wide authority on air navigation and traffic control, the Aural Bearing Generator is a significant contribution to safe flying in all weather.

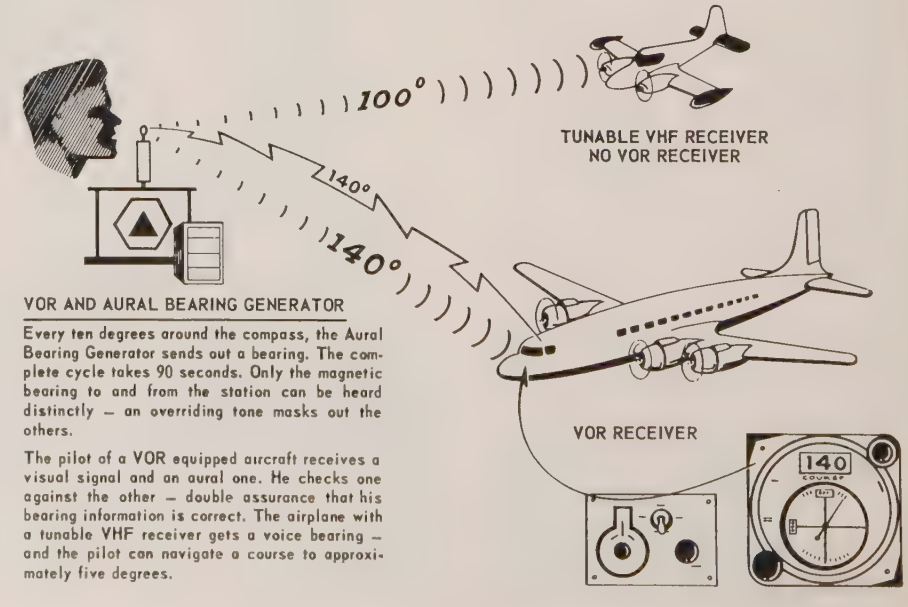
At the present time there are more than 400 standard VOR ground stations operating in the U.S. and abroad. The Aural Bearing Generator is designed to be attached to a VOR station and to supplement its operation without affecting the accuracy of the VOR signal.

The VAOR system, as we call it when the Aural Bearing Generator is employed, provides aural signals which will serve as a check against visual information without the addition of any special airborne equipment. In addition, it has been found that this system, while initially developed as a calibration or error-indicating system for VOR, has wide application as a simplified but accurate navigation system for any aircraft equipped with a tunable VHF receiver.

In operation, VAOR transmits voice signals over the normally unused voice channel of the VOR transmitter. This signal consists of recorded voice announcements reciting magnetic bearings in 10° increments around the compass. The full cycle takes 90 seconds. Simultaneously with the transmission of the aural count a 585-cycle-per-second tone is transmitted in a rotating figure-eight pattern through the VOR directional (non-rotating) antenna. This tone over-rides the voice announcements through the rotative cycle except in the areas of the nulls formed by the figure-eight pattern. For example, an aircraft flying in an airspace due east of the VAOR station would hear the voice announcement "90" in the clear and 45 seconds later the reciprocal bearing "270," other announcements being masked

VOR GROUND STATION ONLY

The pilot of an aircraft equipped with a VOR receiver benefits here. However, the aircraft not equipped with a VOR receiver gets no navigation information whatsoever.



VOR AND AURAL BEARING GENERATOR

Every ten degrees around the compass, the Aural Bearing Generator sends out a bearing. The complete cycle takes 90 seconds. Only the magnetic bearing to and from the station can be heard distinctly – an overriding tone masks out the others.

The pilot of a VOR equipped aircraft receives a visual signal and an aural one. He checks one against the other – double assurance that his bearing information is correct. The airplane with a tunable VHF receiver gets a voice bearing – and the pilot can navigate a course to approximately five degrees.

out because of the over-riding tone.

The ambiguity, if the pilot wasn't aware of his relative position with respect to the station, is simply and quickly solved. If on a track that would take him abeam the station in passing, the successive aural bearings, "90," "100," "110" (as on a southerly flight heading) or "270," "260," "250" would reveal the easterly or westerly position. If the recited bearings remain unchanged, the pilot would know he was on the equivalent track over the station, and a turn right or left to check the change of bearings as above would rapidly tell him if the station was ahead or behind. For example, if a right turn were made, a decrease in bearing would mean the station was ahead, an increase in bearing would mean the station was behind.

Through interpolation, the 10° separation of the voice announcements can be read to an accuracy of approximately 5°. Thus, a pilot can verify aurally through his VHF receiver the information displayed by his VOR indicator.

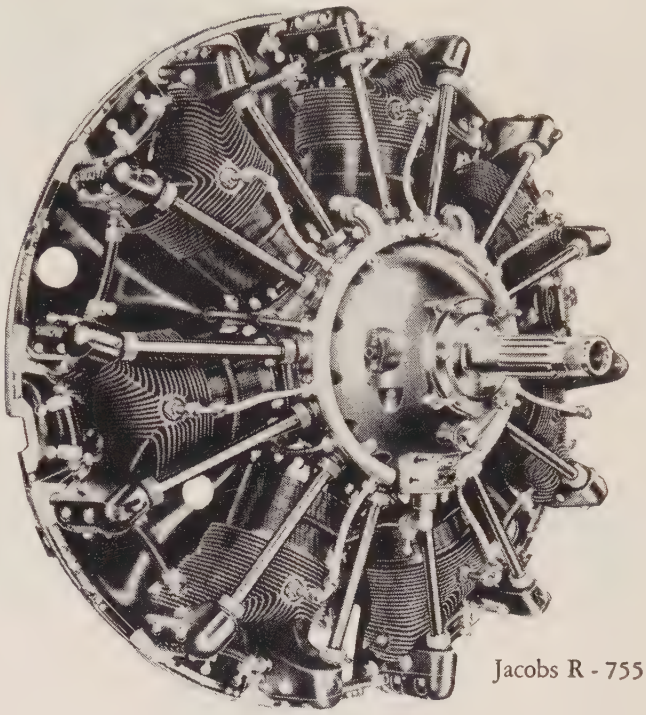
A second advantage with the usual VOR course indicator is that by monitoring the aural count while flying to intercept a desired track, a check can be obtained on the "rate of closure" without constantly changing the course selector. Thus, a smoother and easier "turn-on" to the desired track can be accomplished.

Also, the advantages of dual VOR receiver indications can be achieved with the use of one VOR receiver and a purely communications VHF receiver. Continuous position-fixing within 5° accuracy, rivaling DME and actually easier than dual-VOR computing, can be achieved.

When flying in areas where inherent static might produce instrument aberration, when the VOR receiving instruments fail mechanically, the VAOR (being completely independent) serves as a reliable standby, ready in case of emergency. Even though many aircraft have dual VOR receiving instruments, VAOR can serve as an aural check on their accuracy. Furthermore, in those areas of the world where the accuracies of the VOR system are not necessary, the Aural Bearing Generator, with its own transmitter and antenna, has the capabilities of a VHF Aural-Omni-Range. When this system is utilized, bearing information is also accurate to approximately 5°.

The Aural Bearing Generator is contained in a metal cabinet 42 inches high, 21 inches wide, and 16½ inches deep. Within the cabinet four chassis are mounted (top to bottom): 1) the power supply and side-band generator; 2) the monitor; 3) the magnetic

1953 Hours!



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drum chassis; and 4) the radio frequency bridge. The monitor makes the system "fail-safe" because it automatically shuts down the system if the announced bearings, which are electronically checked for accuracy, are incorrect for any reason.

To be produced and marketed by Union Switch & Signal Division of Westinghouse Air Brake Company, the Aural Bearing Generator was engineered by Melpar, Inc., a subsidiary of Westinghouse Air Brake.

Stability as an Accessory Offered by Lear's ARCON

A great deal of attention has been paid in the aviation press to the safety advantages of partial or complete autopilot systems. So much so, in fact, that any discussion revolves around whether such systems lead to greater or lesser safety. One school of thought argues that frequent employment of such installations tends to make already fully instrument-qualified pilots lax in the maintenance of their proficiencies, with subsequent hazard when unforeseen circumstances compel their return to reliance on their manual skill. This school quotes the experience of some airlines that have had to withdraw their autopilots from service for this reason.

The larger school of thought, however, embraces the employment of auto-control devices as a most desirable pilot aid, easing the burden on the pilot who already is acknowledged to be burdened to the point where efficiency is endangered. This school relies on organizational or personal self-discipline to avoid the hazards feared by the first group.

In the air-carrier group of professional airplane crews, there is no question as to the primary employment purpose of auto-control systems. They are used VFR or IFR without distinction as this group accepts both flight conditions as a routine part of their operations.

In the business-pilot or private-pilot class of operation, especially those involving smaller aircraft, the attitude fostered is that these devices are essentially safety devices for that dreaded moment when a high order of little-used pilot skill may be forced on an unwary pilot. The manufacturers stress the value of their devices in terms of either the luxurious ease-of-flight provided by full autopilot systems or the avoidance of "graveyard spirals" in the case of partial-control systems. The natural reaction of those of the anti-autopilot school is that this approach confirms their suspicions and that human nature will induce "VFR pilots" to stretch their luck that much further. In their opinion, a game of Russian Roulette is more honest than the purchase of such safety aids.

ARCON *centering dial is pointed out on this Tri-Pacer. Contact switch is mounted on lower left portion of control wheel. ARCON can be used on any size plane; unit costs $789*

In this light, the experiment and development research that just resulted in the establishment of an unofficial "180° Rating" designed to qualify "VFR pilots" to safely get out of an inadvertent IFR condition, is a dastardly plot to further encourage such pilots to taste the forbidden fruit of instrument flight.

Someday someone will spread the gospel that no device and no semi-IFR skill will make the careful pilot less so, or the airborne jackass less so. There is no documentary evidence to prove that any pilot on a VFR flight does not have the opportunity at least once to turn back prior to encountering IFR conditions. There is much evidence to confirm that faulty judgment in pushing on has been the major factor in VFR/IFR accidents.

The greatest value of such autopilot devices lies in the incomparable stability advantage that they lend to all conditions of flight. (The obviously happy advantage of systems incorporating radio-navigational track-following ability is not included in this discussion.) A pilot does not have to have an engineering background to be aware that built-in or designed stability in an aircraft has to be paid for in loss of performance or speed. It is no accident that the fastest aircraft at any given horsepower or gross weight requires the greater effort to fly.

Until the introduction of auto-control systems and boosted controls, high-performance aircraft had a very restricted market. Aside from cost considerations, the few non-professional pilots flying single-engine Beechcrafts, Howards, Spartans, etc., were justly regarded as well above average. In the interest of survival, few others tried to conquer these reputedly high-strung aircraft, and businessmen resorted to the airlines for their fast transportation needs.

The science of aircraft design has advanced today to the point where again power and stability are battling to garner the market of both professional and non-professional aircraft. As always, the pilot is in the middle. As the airplane demands more and more of a pilot's effort to control it in flight, less and less is available to deal with the equally important problems of navigation and procedures. Even with a flight engineer to resolve some problems and a radio-operator-navigator to resolve others, two pilots have too much to do if their aircraft is difficult to fly as a result of design sacrifices to speed. Most people today recognize that the third pilot to just fly the aircraft is the autopilot. What then of the school of thought that argues that autopilots are a hazard to the maintenance of manual proficiency? And what of the smaller aircraft crews who reject the full system for the same or other reasons, such as cost?

The answer, of course, is the partial-Control system. The most prominent manufacturer of such systems is Lear, already well established in the full-control system market. Essentially, the Lear ARCON is a device to restore to an aircraft that in-flight stability that the designer took out when he built in high performance. In operation, the device counters any upsetting forces tending to drop a wing and turn the aircraft, such as gusts, turbulence, uneven or shifting distribution of weight via fuel consumption, etc. Although it returns the aircraft to an essentially straight-and-level attitude, as in an aircraft with a high degree of dihedral (and associated extra drag), it does not return it to the original heading as with a full autopilot system. If, in effect, a pilot always had with him an otherwise completely unoccupied person capable of holding the aircraft straight and level in all conditions, he could then devote his attention fully to those other problems that demand a high degree of concentration. This rarely being so for most twin-pilot crews and all single pilots, there is a great market for Lear's ARCON for all sizes of aircraft not equipped with the full auto-control systems.

It is wrong for anyone to attach to any such device the "scare" value implied by suggesting that it is designed to save pilots from the results of their own poor judgment. Like the stall-warning and its brother-device, the Landing Speed Indicator, the ARCON-type stability device should be required equipment on any good-performance aircraft not already incorporating it in the full auto-control system. It should also be expected that designers who strive for means of increasing performance without resorting to more expensive means will rely on the existence of such "stability as an accessory" devices. But for today, any aircraft used primarily for cross-country, from light singles to corporate-size twins, etc., lacking autopilots, needs the ARCON-type device and not just to avoid "graveyard spirals."

Hazeltine DME Receivers Make a Welcomed Debut

When the government contracted with Hazeltine Electronics, Little Neck, N.Y., for the manufacture of 440 DME ground stations located at that many key locations in the U.S., Hawaii and Alaska, it inadvertently may have taken Hazeltine out of the airborne DME receiver market for the purposes of early start competition, *albeit* their design of airborne DME equipment was the first to raise CAA

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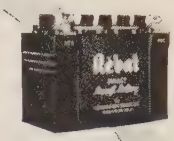

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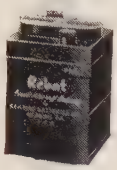

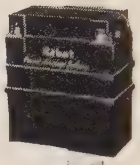

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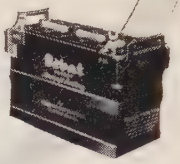

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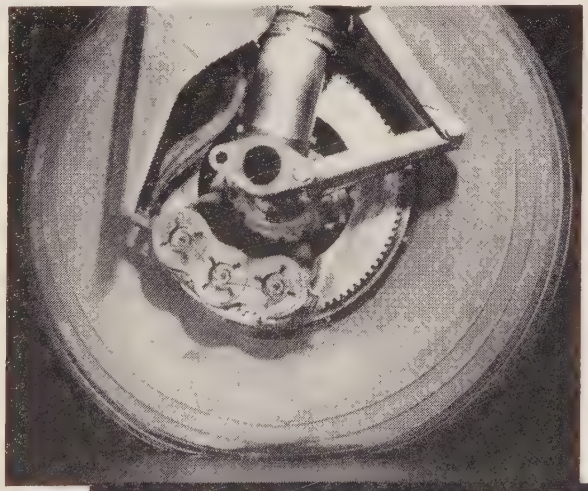

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type certification. In any case, while Hazeltine was busy at the task without which there would have been no DME for the buyers of other airborne DME receivers to use, the other firms have been offering their product for immediate use.

Thus, as in all fields, it was a welcome and healthy thing that at long last Hazeltine entered the airborne receiver market with its Model 1800 and 1810 Interrogators (a more accurate but hardly necessary term for what the pilot will persist in calling a DME "receiver"). Both are 100-channel units designed to the very high standards of performance and reliability synonymous with the name of the manufacturer. *[While the VORTAC decision has stalled further production of this equipment, some sets are available and aircraft owners are purchasing them, VORTAC decision notwithstanding. It is the hope of most that the decision iwll be reversed and that Hazeltine will begin again to produce Model 1800 and 1810 Interrogators on its customary quality and quantity basis.—ED]*

Commercial, military and multi-engine executive aircraft requirements are met by the Model 1800 Interrogator. At its maximum range of 200 nautical miles and at airspeeds up to 700 knots, the unit is accurate to 3%. Remote range indication at any point in the aircraft is provided by either a voltmeter-type or counter-type meter. No additional control equipment is required since channels are chosen automatically by the standard VOR/Glide Slope/DME frequency selector.

For the smaller private and business-type aircraft (both single and light twins), economy and light weight are featured in the Model 1810 Interrogator. Although similar in circuit design to the Model 1800, this unit has a maximum range of 100 nautical miles and accuracy is in the amount of 5% or one nautical mile, whichever is greater. This unit has been designed for mounting directly on an instrument panel if desired, with power supply contained in a separate unit.

The larger Model 1800 operates on 250 watts at 27 VDC, 25 watts at 115 VAC, 400 cps or 100 watts at 115 VAC, 380-1000 cps. The 1810 uses 250 watts at 27 or 13.5 VDC. The former weighs 31 lbs, the latter 23 lbs. The range indicator of the 1800 is dual, 0-40 and 0-200 nautical miles.

The 1800 has a flag alarm on the voltmeter-type range indicator, which shows when the indicator is set for the wrong range, during search, during warm-up, and when power is off or fails. There is none on the 1810, but search is indicated by a light on the indicator panel.

Hazeltine also has offered a solution to the very immediate problem, *i.e.* maintenance of DME. They are offering a DME test coordinator for the highly specialized job of trouble shooting, alignment checking and calibrating of DME airborne receivers. Most of the auxiliary equipments used with the test coordinator are basic tools in an electronics maintenance shop. The remainder will form the nucleus of a generalized test-equipment set-up applicable to the maintenance of all the new UHF pulse-type navaids on the horizon.

Skyways Round Table

(*Continued from page* 19)

"What I would like to know is whether or not the CAA can expect the industry to cooperate with us in the evaluation portion of this project."

David S. Little (*Supt, Navigation Aids & Electronics, American Airlines*): "I'm sure both ATA and ALPA will cooperate to the maximum in an effort to obtain a satisfactory compromise between Configurations A and B. Frankly, we've been disturbed for several months by what has seemed to be undue delay in testing available flush lights. I'm referring to the Dutch Elfaka design which has proved so satisfactory at Schipol Airport, Amsterdam.

"In the Amsterdam installation, which is a modified Calvert system, the lighting configuration has been modified only to the extent that the lateral crossbars are all of equal rather than varying lengths. But more important, the last 1,000 ft of centerline lighting in the Amsterdam installation is of the Dutch Elfaka flush fixture type.

"That field is used by both jets and reciprocating engine aircraft, and I understand that quite a few undershoots have hit the Elfaka lights with no damage to either the lights or the aircraft.

"We understand, too, that the Air Force and the CAA have planned a test installation of a similar Elfaka underrun-area lighting at Knoxville, Tenn. That airport now has the undesirable Configuration B (1,000 ft of side-lighted underrun lighting). If flush-type lights are installed on centerline of the underrun area at Knoxville, ALPA and ATA could and would provide pilots and airplanes for any evaluation the CAA might wish to make."

J. D. Smith: *"Mr. Egan, may we have your comments?"*

Richard Egan (*Vice Pres., Structural Concrete Products Corp.*): "At the present time, Elfaka flush lights are in operation at eight airports in Holland, one of which is an airport used by a USAF jet squadron. At that airport there are sufficient flush lights in the complete approach and overrun area to prove efficiency and adaptability of the lights to meet the pilot's need for visual aids to come through fog and other inclement weather conditions. It would be helpful if Mr. Clement could get a report directly from the squadron using the Soesterberg, Holland, airport on what those pilots think of the lights.

"We appreciate, too, the CAA's assistance in having our lights tested by the Bureau of Standards. I might add that we have two well-known American companies who are ready to manufacture the grids and light boxes for us."

Robert J. Alpher (*Deputy Chief, Plant Structures, CAA*): "Photometric, static and dynamic tests are now being made at the Bureau of Standards for both the CAA and the AF. Together with the test installation, these will indicate what changes, if any, will have to be made in the flush light units to make them acceptable."

J. D. Smith: *"As a representative of the Navy, Mr. Lewis, would you outline the Navy's thinking on approach lighting?"*

Amos L. Lewis (*Acting Head, Visual Landing Aids, BuAer, USN*): "The Navy requirements for approach lighting differ from those of both the Air Force and the CAA in that, a) a number of our aircraft, particularly fighters, have poor forward visibility during landing and take-off; b) for these types of aircraft a very limited area longitudinally for touchdown must be used ultimately; c) there also is a severe lateral limitation in landing area for some types of naval aircraft operations; and d) for carrier-type operations, closer approach control is possible through the landing signal officer. Accordingly, it is desirable to provide approach and runway lighting suitable for the most critical types of aircraft with respect to forward visibility. In view of all this, there appears to be no Navy requirement for undershoot or overrun areas.

"The Navy's Composite System of approach lighting is the result of tests at the Naval Air Test Center, and is a composite of the Slopeline System incorporating the better features of the British approach lighting system. This system provides 1) centerline indication for aircraft having good forward visibility; 2) glide path indication for all types of aircraft; 3) roll guidance; 4) a positive indication of either small or large increments of displacement to right or left of the centerline, even though the pilot may see only a small portion of the approach light configuration; 5) a positive indication of the imminence of the threshold by a marker 1,000 ft therefrom; 6) better lateral coverage; 7) definite threshold marking; 8) the pilot may fly any one of three converging lines to touchdown, knowing exactly which line he is following and what his final heading correction must be; 9) it contains the basic characteristics, threshold bar, 1,000-ft bar, and centerline of the favored ICAO configuration, plus those features considered necessary for over-all Navy use; 10) it provides excellent texture or ground plane definition; and 11) it is Configuration C of the NSI."

George Clement: "The AF problem involves the multiple echelon landing and the composite operation. In this it doesn't make any difference whether you consider one

airplane, a flight, a squadron or a group. It takes a minimum of one runway with all support to construct a basic military airport capable of supporting an interceptor fighter operation. Such an airport costs about $50,000,000.

"Now, there are certain areas in the U.S. which must be protected, and the aircraft used to protect these must be based so that their radius of action takes in those areas. In many cases this means the military aircraft have to be based at civil airports. In fact, I'd say 90% of our defense aircraft probably will be based at civil airports. In such cases, the AF will expand the fields and will provide support facilities designed to meet AF needs.

"Our present policy on runway lighting is to use high-intensity runway lights on every new or rehabilitated runway whose length, width, strength and clearances are capable of supporting IFR operation.

"Further, at every airport where there is a military operation, there must be a minimum of one approach lighting system and any other such approach lighting systems determined to be operationally required. Note that we are not limiting approach lighting to one system or two systems, but rather to the number *required* for operations. Conditions at the field determine how many systems are needed.

"I don't want to get into any controversy between ILS and GCA, but the AF would like to use GCA, even though it does use ILS in some cases. Current GCA equipment can be sited to provide approach coverage for several approach combinations and is capable of yielding primary coverage to more than one runway.

"As long as we have human beings in the driver's seat of these aircraft, we're going to require visual aids. It makes no difference whether or not the automatic landing is perfected. It's a mechanical device subject to failure, and manual landings will have to be continued."

Frank Brady: "It seems to me the fundamental problem is trying to design to the least common denominator, and that gets us into trouble. In trying to provide for the requirements of the most difficult aircraft, we find ourselves in the position of having to add and add system elements. Then when you back off and look objectively at what you have, you may find that the added elements have ruined what was otherwise a perfectly good system."

J. D. Smith: *"Time and tape seem to be running out on us for this month's portion of the discussion. Therefore, I'll now summarize this first half of the whole subject of approach lighting, and then we'll go on with the rest of the discussion.*

1. "At the present time we have a national hodge-podge of approach lights, and this should be replaced by standard systems as soon as practicable.

2. "Although a national standard for approach lights has been issued in an attempt to obtain uniformity, its practical applications have only served to confuse the issue. There is still no agreement between the Air Force and the Commercial carriers on one approach light configuration suitable for both jet and piston-engine operations.

3. "The Air Force has failed to adhere to the national standard at several joint-use airports, installing instead modified versions of Type B configuration or systems inconsistent with any recognized criteria.

4. "The failure of all interested groups to agree on a single standard acceptable to military and civil interests using the same airports has created constant points of conflict.

5. "The CAA does not believe that another study by another agency would serve any useful purpose at this time. The CAA believes that an extensive test of flush-type fixtures, such as those installed at Soesterberg in the Netherlands, may solve the problem of how best to light undershoot areas in approach systems.

6. "There appears to be general agreement among the Round Table participants that, until a full-scale evaluation of flush lights is undertaken, undershoot areas at joint-use airports will continue to be a major problem.

"The concluding portion of the Round Table next month will point up the seriousness of making 200 and ½ approaches and 200 and ¼ take-offs at airports where there are no centerline approach lights. It also will present the Navy's reason for retaining side lighting and roll guidance in approach lighting, and will point the way to a satisfactory resolution of the problem of approach lighting which has been a big issue in aviation for the past 15 years."

Aircraft Spacing

(*Continued from page* 15)

a specified region chosen for study. One might select any of several of the high air traffic level airways. Suitable runs might be New York to Washington, or Chicago, or Los Angeles to San Francisco.

Most of the aircraft using the selected airway would be equipped with transponding beacon equipment which might be similar to that shown in *Figure 1*. The intention is to cause each equipped aircraft to interrogate all nearby traffic and to record the instances where the proximity is less than some reference value, say, five miles. Each craft would put out inquiring pulses which would be answered by any craft at its altitude and within the selected range. Any craft at the same altitude as that of the interrogating airplane would respond if within five miles, while aircraft at other altitudes would ignore the interrogation, even though they might be directly over the same ground point as the interrogating aircraft. The recorder would make a record of any replying responses received.

Techniques to accomplish this are well known, stemming from the radar work pioneered at MIT's Radiation Laboratory during World War II.

The functioning of the equipment may be described this way: the transmitter initiates pulses at the relatively slow rate of, say, once per second. A timing device in the receiver stands by for a return pulse within the elapsed time which represents a five-mile maximum distance. If the receiver detects no pulse, its sensitivity is briefly cut off after five miles by a disabling voltage from the timer unit, and thereafter the

(*Continued on page* 41)

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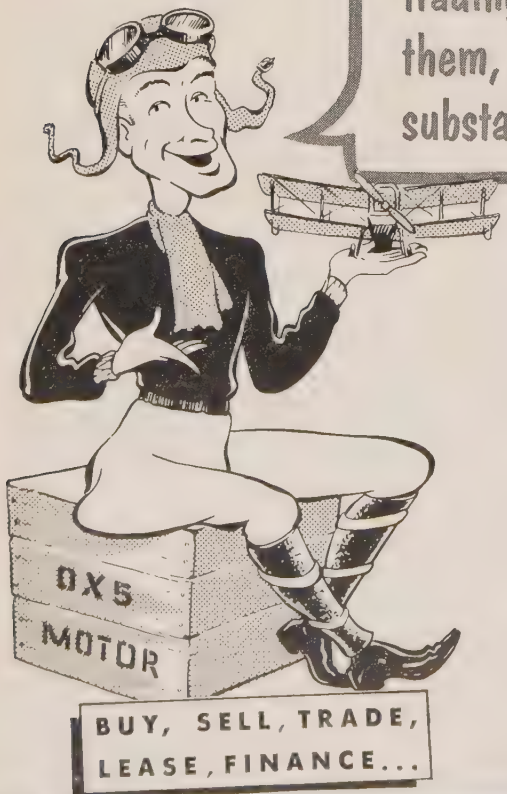

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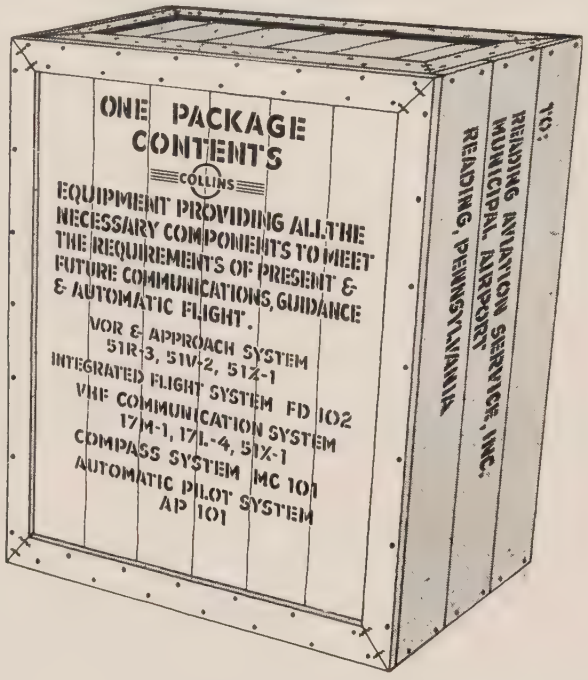
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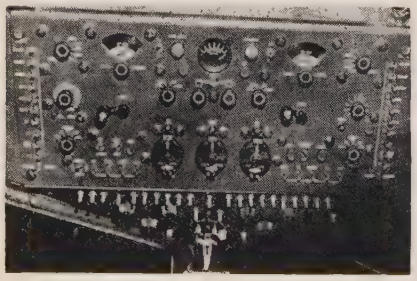

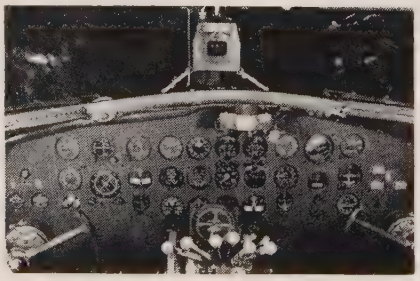

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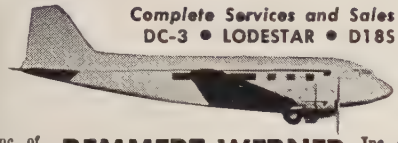

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Aircraft Spacing

(Continued from page 37)

system becomes alert for an interrogation from any other similarly equipped aircraft within range. Since the period of time required for the return of the pulse from the five-mile distance is only some 50 millionth of a second, and since interrogations are to be repeated only once per second, there is a lot of spare time between transmissions which may be used for the purpose of listening for other aircraft equipped with the same instrumentation and to whom a replying pulse might need to be directed.

Thus, there are two modes of operation occurring alternately. One mode is the interrogation. We have pulses every second traveling along the connection E; they are fed into the transmitter which initiates pulses, and into the receiver where the timing mechanism is indexed. The transmitter pulses go out on the cable marked "A" and are radiated into space from the antenna. When reply pulses are received from other aircraft, they travel down the cable B and into the receiver where, when the decoded and timed evidence indicates that they come from a craft at the same altitude and within five miles, recordings are made on the recording device. The time of day also is recorded so that future study of the records can resolve the geometry involved and permit identification of the craft whose reply was received. The recording includes coded data on distance. More than one replying aircraft can be accommodated.

The other is the replying mode which involves receipt of pulses from some aircraft in space. Such pulses travel down the cable marked "B" and into the receiver. After appropriate decoding, reply pulses generated through the connection C are emitted from the transmitter. These pulses travel along cable A out to the antenna where they are radiated into space.

The receiver and transmitter, then, function in two modes. The first is the call out into space and the listening for responding echoes. The second is the listening for interrogations, and the sending of responding pulses. The former mode occupies about 1/20,000th of the time between one-second pulses. This means that most of the time the set is listening for requests for reply from other aircraft, and thus double duty can be performed with no lost time.

As I noted before, the instrumentation of the aircraft for the measurements has the disadvantage of expense, maintenance and extra weight. In round numbers the cost per installation might be $2,000 per aircraft; the weight might be held under 50 lbs, including antenna and recorder. Whether or not airline operators could be persuaded to cooperate in the interest of getting data in spite of these disadvantages is a question that cannot be answered now.

Such an installation as has just been described can be engineered to perform the stated function—the automatic monitoring of spatial separation. However, it should not be so engineered unless an analysis of this difficult and important problem discloses a real need for, and value to be gained from, this type of information, a value measured in terms of increased efficiency of utilization of our airspace with no loss of safety. ✈

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(*Continued from page* 13)

would see if he were flying in clear weather. The tube would not interfere with visibility in VFR weather.

Developed as a proprietary item by Willys Motors, Inc., the flat TV tube has created much comment in the television industry. It is only three inches thick, compared with an average depth of 20 inches for a conventional TV tube. It utilizes a standard electron gun and beam, but the beam is compressed by powerful focussing action and can provide 2,000-line scanning as against 525-line definition of home sets.

In addition to the circular TV tube, the horizontal instrument panel which slopes toward the pilot like an artist's table has a master switch, a landing gear lever (wheel-shaped), a "Power Unsafe" light, a Formation Rendezvous button (shaped like an airplane), a fire indicator, a communications dial, flap lever, an interior and exterior lighting switch, an air conditioning dial, the control stick and a power control lever calibrated at "Take-Off Max," "Take-Off Norm," "Climb—High-Speed," etc.

The new instrument panel is a development of the Office of Naval Research, the Bureau of Aeronautics and Douglas Aircraft. Project engineer has been A. M. Mayo, of Douglas. The Navy reports that it expects the first experimental aircraft using this new panel to be flown sometime in 1958.

Elfaka Lighting

(*Continued from page* 9)

flush overrun lights and without side lights. The Air Force has insisted on side lights as a necessary aid to jet pilots who must land their aircraft in a nose-high attitude and, therefore, have limited forward visibility.

The powers-that-be agreed to retention of the side lights in this planned Knoxville test in the belief that after the military has flown the centerline installation, it would realize the adequacy of that system and find no need for side lighting.

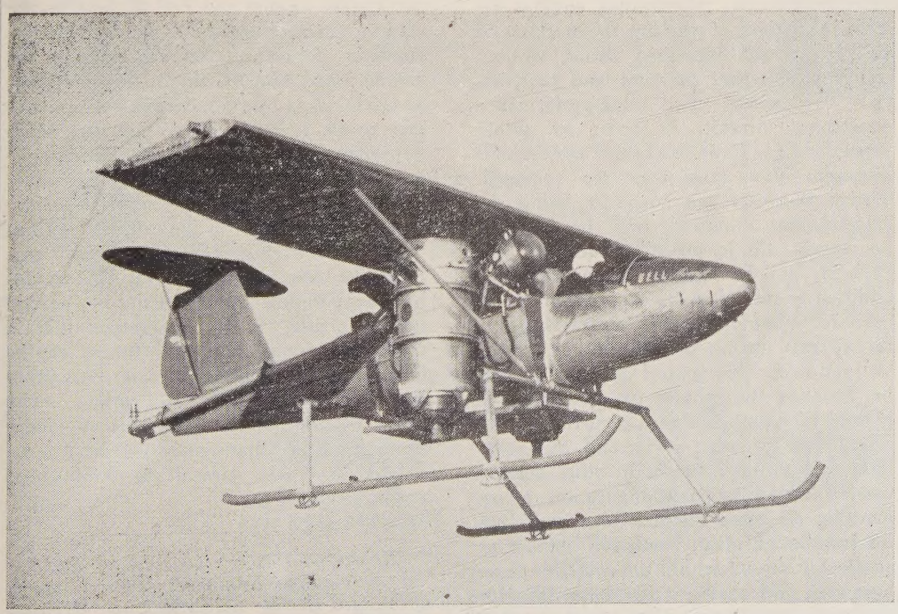
In preparation for the Knoxville test installation, which is scheduled for completion by late spring, the CAA sent a pilot to Europe to fly the Schipol and Soesterberg flush light systems and report his findings. His report, plus testimony at the CAB's mid-February hearings on the Italian Airlines DC-6B accident which destroyed part of the slope-line approach light installation at New York International Airport, may hasten the actual start of the Knoxville test.

However, the general agreement on flush lights as the means of solving the problem of overrun or undershoot areas at joint-use airports has not brought an end to the conflict between the Air Force and the air carriers on how best to handle new approach lighting systems in the interim period.

Soon after announcement of the Knoxville test, the CAA added fuel to the approach light battle by reporting that the controversial Configuration "B" system is planned for Logan International Airport at Boston this year. Terrain problems were reported to be contributory reasons for this decision. The Air Line Pilots Association, however, immediately announced that the B-Type installation at that joint-use airport would be strongly opposed.

Bell's Revolutionary VTOL

Strange indeed are some of the aircraft coming off the drawing boards these days, and among the latest is Bell's VTOL, a jet-propelled vertical rising airplane which can take-off and land without need of a runway *(see cover)*. Employing an entirely new principle of aircraft flight, Bell's development uses twin jet engines to provide thrust for vertical operation and horizontal flight. The two Fairchild J-44 turbojet engines, each delivering about 1,000 pounds of thrust, can be rotated from a vertical position for take-off and landing to a horizontal position for forward flight. With this exception, the Bell VTOL performs like a conventional fixed-wing airplane. For take-off and low-speed flights, compressed air is ejected from nozzles at the wing tips and the tail of the aircraft to provide pitch, yaw and roll control. When sufficient forward speed is attained, flight control is provided by conventional control surfaces, ailerons, rudder and elevators. Test pilot for the Bell VTOL is David W. Howe. The test vehicle weighs 2,000 pounds; is 21 feet long and has a wing span of 26 feet. It carries only the pilot. The aircraft incorporates a glider fuselage, a commercial lightplane wing and a helicopter landing gear. Bell used its own funds to build the craft, and the only government assistance has been with the engines, on loan from the AF.



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3-55

Installation Barrier

(*Continued from page* 12)

The developed system provides for rapid cooling of the hot engine and exhaust, and inertness by a spray of water.

An exterior spray on the hot surfaces generates a steam layer which prevents ignition of fuel that otherwise would be intimate with the hot surfaces. An interior spray is provided to rapidly reduce the metal temperature. Tests at NACA facilities have demonstrated that the system can prevent crash fires due to the engine and exhaust system acting as ignition sources. A contract recently was awarded for the development of a system which will be integrally incorporated on the exhaust system. The development of such a system is considered mandatory to insure that it will be satisfactory for service use. Both the gas-turbine and reciprocating-engine installations will be developed and tested during this fiscal year. The installation will require space provisions for a water tank and equipment to initiate flow upon crash.

Induction System

The induction system on supersonic aircraft is becoming more complex and so affects the performance of the engine that its configuration must be meticulously designed and its location judiciously chosen. The induction system serves one primary purpose and that is to supply air in proper quantities and quality to insure efficient engine operation. The air must be of a high energy level, without separation, with a uniform pressure profile, and be free of foreign matter that may destroy the engine. To prevent entry of such articles, it is necessary that some type of barrier be placed in the flow path. Several types of screens have deen developed which would prevent entry of articles having dimensions larger than a ¼-inch sphere. The screens can retract from the flow path during periods when protection is unnecessary. In order to insure that the flow surfaces of the induction system will not accumulate ice during operation in cold humid air, it is necessary that an adequate anti-icing system be installed. This anti-icing system must be coupled with an adequate ice detector to make certain that an icing condition will be detected and that protection will be provided before a potential damaging thickness of ice can accumulate.

Both the foreign article protection with the screens and the ice protection provided by the anti-icing and ice-detector systems must be supplied for the supersonic aircraft as well as the subsonic aircraft. The fact that foreign articles can be ingested during some portion of the mission of the aircraft must be acknowledged and protection provided. During any subsonic portion of the flight, icing could occur and the most dangerous period would be during let-down. Even at low supersonic speeds, when the stagnation temperature rise plus the ambient temperature exceeds the freezing point, the ice may still form on trailing surfaces and in areas where a sudden expansion of air occurs. Therefore, there is a need for all high-performance aircraft assigned to all-weather missions to have foreign articles and icing protection.

The Air Force already has under contract a study to establish design criteria for screens and to develop a more satisfactory article than is presently available. A report covering this study and establishing design parameters is now complete and shortly will be available for distribution to industry. In addition, the Air Force has other programs underway for the development of lighter weight, lower loss and better screening configurations.

The problems of providing icing protection with an engine-bleed thermal anti-icing system long has been recognized untenable with present methods during periods of operation when the bleed capacity is reduced. During let-down, when engine thrust and the capacity of the bleed systems is reduced, the available anti-icing energy is likewise reduced. For this reason, development is necessary for a system which will provide additional anti-icing energy either to the low-energy bleed air or to a separate fluid. Preliminary sudies indicate that, with very little weight increase, energy can be supplied to adequately augment the available bleed-air energy during these periods.

Exhaust System

The exhaust system is distinctly an airframe part only on non-afterburner engine propelled aircraft. As the need continues for more thrust to get more speed out of the aircraft with little increase in the weapons system weight, the afterburner will be a prominent feature on military aircraft. However, for the transport-type aircraft, the afterburner with its high specific fuel consumption cannot be tolerated. For whichever type, the afterburner or tailpipe, the exhaust system and associated items will present a major installation problem on all high-performance aircraft.

The problem will become worse before it becomes better. Some current non-burner installations have a tailpipe with a simple circular nozzle with possibly some provision for tabs to be attached to adjust the nozzle outlet area within a few square inches above and below design for standard conditions. Before many years, it is very probable that the exhaust will become one of the most important parts of the entire engine installation. Afterburner engines require a method of varying the nozzle exit area to permit increased thrust without exceeding internal pressure and temperature limitations. For high-performance supersonic aircraft, in order to obtain supersonic gas flows, a suitable convergent-divergent flow area must be provided. Thrust reversers are currently being developed that eventually will be installed on nearly all jet-propelled aircraft and probably will be located at the nozzle. In addition to this, there is an ever-increasing need for other directional control features for aircraft during ground roll on icy or wet runways. This control can be obtained by deviating the exhaust gas flow from its normal flow path. There are currently considerations for other items and configurations at the nozzle to obtain other desired results. Obtaining a configuration incorporating all these features plus providing for installation of an insulation blanket or an ejector shroud within the available fuselage area and having a low base drag for the entire installation, is going to entail a few years of concentrated design effort. The nozzle configuration not only becomes complex but the control and actuation system installation renders a major problem.

Summary

The supersonic aircraft must be designed to obtain maximum aerodynamic qualities. The aircraft must be capable of lifting a large payload a long distance at high speeds with a minimum expenditure of fuel. To achieve this goal, the designer must utilize a powerplant of tremendous power; it must be small in weight and volume and it must have low specific fuel consumption.

The selection of powerplant is dependent on several factors. The paramount consideration is performance. This is largely due to the fact that the power requirement is proportional to the cube of the aircraft speed. However, ultimately the powerplant must have good installation and serviceability features.

For many years the engine installation was considered only to be the wiring and plumbing of the engine to the airframe. Now, however, in supersonic aircraft the engine is a means of imparting energy to a complex and sensitive flow system which begins ahead of the induction inlet and ends behind the exhaust nozzle. The efficiency and the complexity of the flow-system configuration is influenced by the vast range of operational conditions, *i.e*, aircraft speed and altitude, and the location of the engine relative to the airframe.

The aircraft must have good supersonic aerodynamic characteristics and, therefore, will have thin wings and a clean fuselage. In comparing weight distribution in jet transports *vs.* reciprocating-engine transports having equal payloads, it is shown that for the jet the fuel weight is doubled, powerplant weight is nearly halved, airframe weight is increased about a fifth, and the weight of other items remains equal. Actually, in some installations the engine and fuel may constitute 60 to 65% of the total aircraft weight. Therefore, engine installation and fuel storage will be the largest factor in determining aircraft drag.

Airframe changes can be made to accommodate the engine and fuel as long as the exterior surfaces are aerodynamically clean. However, if compromises are made in the engine installation to obtain this end, then severe losses in over-all aircraft performance may result. It is imperative that paramount importance be placed on the engine-installation problems in early design stages of the aircraft. If not, the installation barrier will continue to be a very serious problem. New equipment of increased performance, low weight and satisfactory for high-temperature environments is needed now. Further, it is imperative that a thorough over-all study of future engine installations be conducted to forecast problems which eventually will arise; many items will be added, many will no longer be required and many more will have to be deleted from the aircraft to retain high performance.

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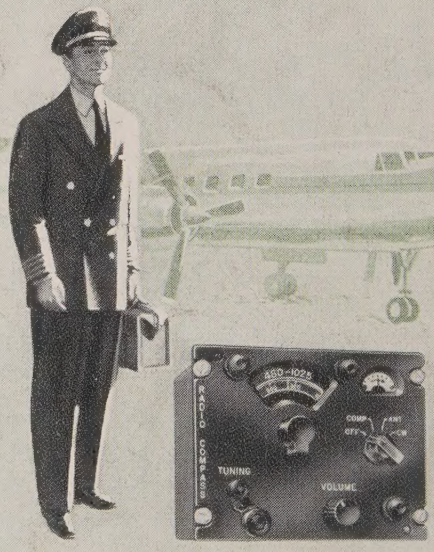

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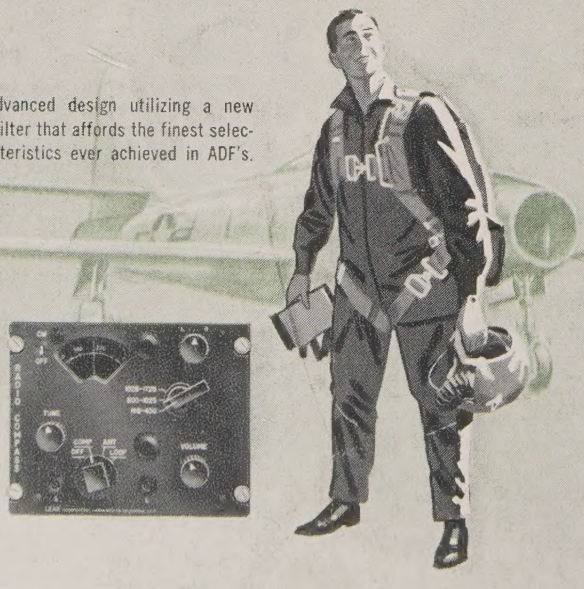

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